California Air Resources Board

Revised
Quantification Methodology for the
Strategic Growth Council
Affordable Housing and Sustainable Communities Program

Greenhouse Gas Reduction Fund
Fiscal Year 2016-17

Final Revised
October 2, 2017

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Updates

The California Air Resources Board (CARB) updated the Fiscal Year (FY) 2016-2017 Affordable Housing and Sustainable Communities (AHSC) greenhouse gas (GHG) Calculator Tool, posted June 5, 2017, to include a new co-benefit summary tab to report key variables and air pollutant emission estimates from proposed AHSC projects. This ~~Draft~~ Final Revised AHSC Quantification Methodology was updated as necessary to reflect updates to the~~is~~ ~~Draft~~Final Revised AHSC Calculator Tool. A summary of the updates to the AHSC Quantification Methodology, posted June 5, 2017, is presented by section in the tables below. For more information, a detailed list of the updates can be found on page 6 of this Final Revised ~~Draft~~AHSC Quantification Methodology.

General (all sections)

Item Updated	Description of Update
Revised	
AHSC Calculator Tool	Updated to include a new co-benefit summary tab to provide key variables and air pollutant emission estimates. Applicants will need to complete the Final Revised AHSC Calculator Tool; however, no additional inputs are required.
~~Draft~~ Final Revised Quantification Methodology	Updated as necessary to reflect updates to the ~~Draft~~ Final Revised AHSC Calculator Tool.
CARB Quantification Methodology Template	Updated the format of this Final Revised ~~Draft~~ ASHC Quantification Methodology to the latest template for consistency with other Greenhous Gas Reduction Fund Program quantification methodologies to provide key variables and air pollutant emission estimates.

Section B. Quantification Methodology Using CalEEMod

Item Updated	Description of Update
Revised	
Transit Subsidy for Residents	Set the number of residents eligible for subsidies to one eligible resident per dwelling unit~~ consistent with AHSC Program Guidelines requirement to provide one subsidy per unit~~.

Section C. Quantification Methodology Using TAC Methods

Item Updated	Description of Update
Added	
Clarification for Project Area	Project Area for pedestrian and bike facilities have been aligned with the AHSC Project Area Guidance for Sustainable Transportation Infrastructure.

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Table of Contents

Section A. Introduction

The goal of California Climate Investments (CCI) is to reduce greenhouse gas (GHG) emissions and further the purposes of the Global Warming Solutions Act of 2006, known as Assembly Bill (AB) 32. The California Air Resources Board (CARB) is responsible for providing the quantification methodology to estimate the GHG emission reductions and other benefits from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). CARB develops these methodologies based on the project types eligible for funding by each administering agency as reflected in the program Expenditure Records available at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/expenditurerecords.htm. CARB staff periodically review each quantification methodology to evaluate its effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified.

For the Strategic Growth Council's (SGC) Affordable Housing and Sustainable Communities (AHSC) Program, CARB staff developed this Final Revised AHSC Quantification Methodology and Final Revised AHSC Calculator Tool to provide methods for estimating GHG emission reductions and air pollutant emission estimates (Section B and C), provide instructions for documenting and supporting the estimate (Section D), and outline the process for tracking and reporting GHG emission reductions and other benefits once a project is funded (Section E).

This methodology uses tools to estimate the change in vehicle miles traveled (VMT) and associated GHG emission reductions and air pollutant emission estimates based on specific land use and transportation characteristics of AHSC projects. These tools consist of components of the "California Emissions Estimator Model" (CalEEMod) version 2016.3.1 and calculation methodologies based on the "Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects" (CMAQ Methods)[i].

The CMAQ Methods were used as the basis for developing the GHG emission reduction and air pollutant emission estimates for certain project features that are not captured in CalEEMod, specifically transit and connectivity (TAC) features. The CMAQ Methods document is available to download from https://www.arb.ca.gov/planning/tsag/eval/eval.htm. However, all of the equations and assumptions needed for this quantification method are included in this document and some assumptions have been modified as necessary. Therefore, the equations used in this Final Revised Quantification Methodology are referred to as TAC Methods. Projects will report the total project GHG emission reductions estimated using this methodology as well as the total project GHG emission reductions per dollar of GGRF funds requested.

In an effort to enhance the analysis, provide greater transparency, and assist in project-level reporting, CARB also included an additional output tab in the Final Revised AHSC Calculator Tool that summarizes key variables and air pollutant emission estimates for select criteria and toxic air pollutants from AHSC projects. Key variables estimated include: passenger VMT reductions and number of housing units per acre.

The Final Revised AHSC Calculator Tool calculates air pollutant emission estimates, using the same methodology as for GHG emissions estimates, for the following criteria and toxic air pollutants: reactive organic gases (ROG), nitrogen oxide (NO_x), fine particulate matter less than 2.5 micrometers ($PM_{2.5}$), and diesel particulate matter (diesel PM). .

AHSC Project Types

The AHSC Program will reduce GHG emissions through projects that implement land use, housing, and transportation strategies to support infill, compact, and affordable housing development projects. The AHSC Program identifies three project area types: Transit Oriented Development (TOD), Integrated Connectivity Projects (ICP), and Rural Innovation Project Areas (RIPA). For GHG quantification purposes, projects that include affordable housing or housing related infrastructure will primarily use CalEEMod. Projects without a housing-related component will use the methodologies from the TAC Methods.

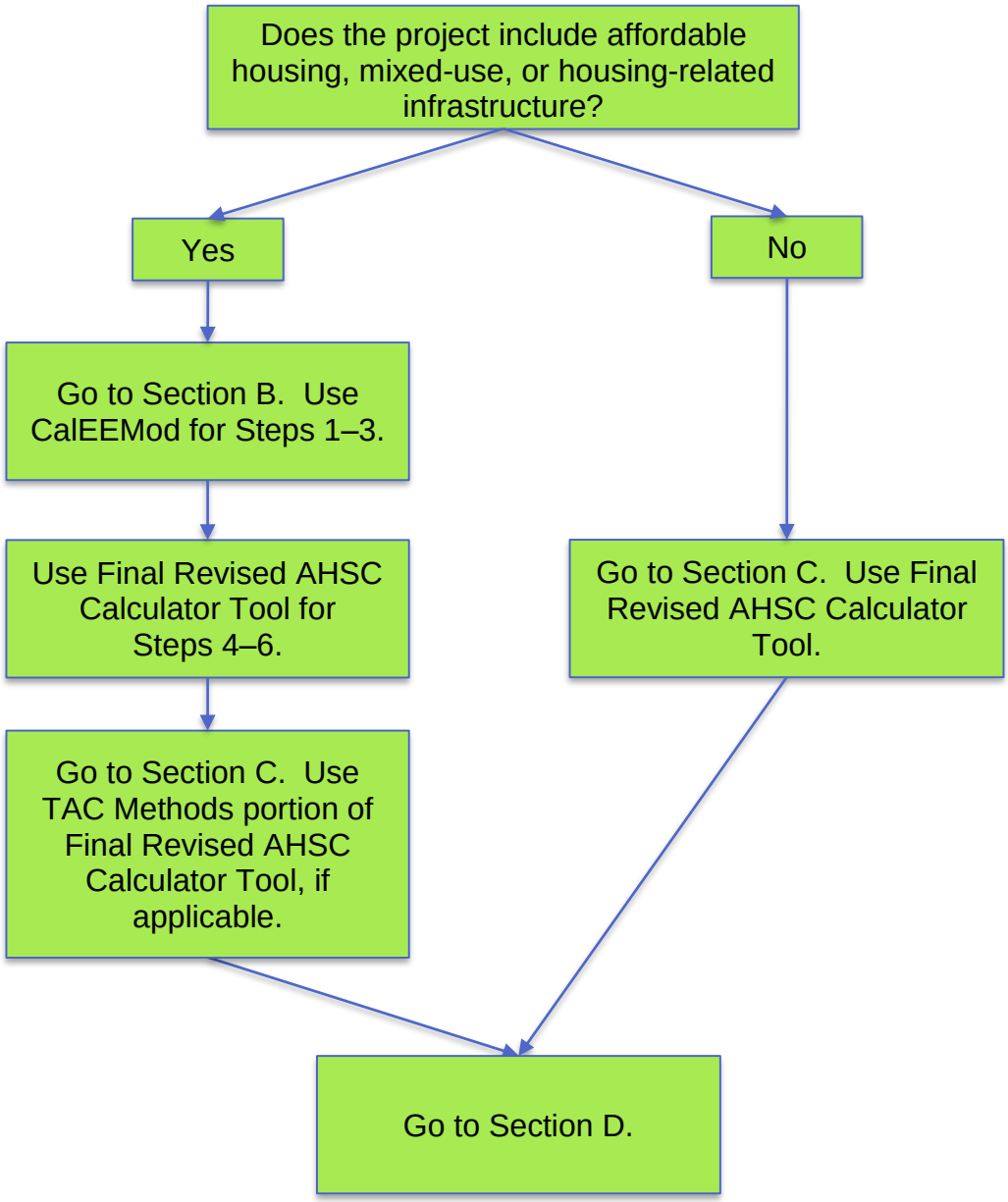
Table 1 lists the most common project types SGC expects to receive in the AHSC Program and identifies which quantification method would likely be used to estimate GHG emission reductions. For some projects, it may be appropriate to use both methods. Appendix A includes an example project that uses both methods.

Table 1. Example Project Features and Quantification Method(s)

AHSC Project Features	CalEEMod	TAC Methods
Affordable housing (including affordable housing developments, housing-related infrastructure, and substantial rehabilitation of housing)	X	
Mixed-use development	X	
Regional transit projects (e.g., new bus service, vanpools) not associated with housing or other land use development components		X
Sustainable Transportation Infrastructure (e.g., pedestrian facilities, bicycle paths, bike lanes, bikeways,) that encourages mode-shift		X
Transportation-Related Amenities (e.g., bus shelters, benches, etc.) that encourage mode-shift		X
Affordable housing AND regional transit project	X	X

Figure 1 below outlines the process for calculating the GHG emission reductions and air pollution emission estimates for a proposed project.

Figure 1. Quantification Methodology Flow Chart



Methodology Development

CARB and SGC developed this Final Revised AHSC Quantification Methodology consistent with the guiding implementation principles of CCI, including ensuring transparency and accountability.[ii] CARB and SGC developed this Final Revised AHSC Quantification Methodology, through a public process, to be used to estimate the outcomes of proposed projects, inform project selection, and track results of funded projects. The implementing principles ensure that the methodology would:

- Apply at the project-level;
- Provide uniform methods to be applied statewide, and be accessible by all applicants;
- Use existing and proven tools and methods;
- Use project-level data, where available and appropriate; and
- Estimate GHG emission reductions and air pollutant estimates from a discrete list of VMT reduction measures.
- Reflect relationships between VMT and GHG emission reductions that are supported by empirical literature.

CARB reviewed peer-reviewed literature and tools and consulted with experts, as needed, to determine methods appropriate for AHSC project types. CARB also consulted with SGC to determine project-level inputs available. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

In addition, SGC held three public "Lessons Learned" workshops in December 2016 to discuss comments from applicants on the fiscal year (FY) 2015-16 AHSC application and selection process. CARB attended the workshops to listen to comments specific to the AHSC Quantification Methodology for FY 2015-16. The input from applicants at the Lessons Learned workshops helped to inform the updates in this AHSC Quantification Methodology, posted June 5, 2017.

CARB and SGC released the Draft SGC AHSC GHG Quantification Methodology for FY 2016-17 and Draft AHSC GHG Calculator Tool for public comment in March 2017. A supplemental public comment period specific to proposed project setting changes was held in May 2017. Public comments were included, where appropriate, and a Final FY 2016-17 AHSC GHG Quantification Methodology and accompanying AHSC GHG Calculator Tool were posted on June 5, 2017. Subsequently, thise Final Revised AHSC Quantification Methodology for FY 2016-17 and Final Revised AHSC Calculator Tool have been updated to ~~also~~ provide outputs for key variables and air pollutant emission estimates.

Applicants must use this Final Revised AHSC Quantification Methodology, in conjunction with the accompanying Final Revised AHSC Calculator Tool, to estimate the GHG emission reductions and air pollutant emission estimates of the proposed project. The Final Revised AHSC Calculator Tool can be downloaded from: www.arb.ca.gov/cci-quantification.

Tools

This Final Revised Quantification Methodology and the Final Revised AHSC Calculator Tool rely on project-specific outputs from the following tools:

CalEEMod is a "state-of-the-practice" land use emissions calculator tool designed to quantify GHG emissions and criteria air pollutants associated with land use development projects, including transit-oriented developments and mixed-used developments. CalEEMod is used statewide by lead agencies to evaluate the GHG emissions and criteria air pollutants of land use development projects pursuant to the California Environmental Quality Act, the National Environmental Protection Act, and for compliance with local air quality rules and regulations. CalEEMod includes a suite of mitigation measures so that a user may compare mitigated and unmitigated project emissions. The GHG emission reduction impacts of the mitigation measures were developed by and are detailed in a study conducted by the California Air Pollution Control Officers Association (CAPCOA) titled "Quantifying Greenhouse Gas Mitigation Measures" (CAPCOA Quantification Report).[iii] The CAPCOA Quantification Report includes detailed fact sheets that describe the underlying research and the data used to develop the reduction impacts (also called effects or elasticities) and provide project level examples for each measure. The CalEEMod tool, User's Guide, and other supporting documents can be downloaded from www.caleemod.com.

The CMAQ Methods are a set of equations for evaluating the cost-effectiveness of certain types of transportation projects, including bicycle paths, vanpools, and new bus service. The CMAQ Methods were developed by CARB and the California Department of Transportation, and are used statewide by transportation agencies to evaluate criteria pollutant emission reductions from transportation projects competing for State motor vehicle fee and federal CMAQ funding.

CalEEMod and the CMAQ Methods are used statewide, are publicly available, and are subject to regular updates to incorporate new information. The tools and documentation are free of charge and available to anyone with internet access. Both methods require land use characteristics and VMT reduction features from the proposed project, which should be readily available in the project application.

In addition to the tools above, this Final Revised Quantification Methodology relies on CARB-developed emission factors. CARB has established a single repository for emission factors used in quantification methodologies, referred to as the CCI Quantification Methodology Emission Factor Database (Database).[iv] The Database Documentation explains how emission factors used in CARB quantification methodologies are developed and updated. The Dd~~d~~atabase includes new emission factors for criteria and toxic air pollutant and no changes have been made to the GHG emission factors. ~~CARB is also accepting public comments on the Database and Database Documentation as part of the Quantification Methodology and Tool until September 29, 2017 via GGRFProgram@arb.ca.gov~~.

Updates

CARB updated the ~~FY 2015-16~~ AHSC Quantification Methodology for FY 2015-16 to enhance the analysis and provide additional clarity to project applicants. The changes made are lists below by section.

General

- Updated format of thi~~s~~e Final Revised Quantification Methodology to match the latest quantification methodology template
- Parking is an in-eligible AHSC Program cost; however, parking measures continue to be allowable in th~~e~~is Final Revised Quantification Methodology because of benefits associated with parking reduction
- The designation of "retirement community" will continue to be used for senior housing projects designation

A. Introduction

- Revised Table 1 to closer align with AHSC project types
- Updated the Updates sub-section to indicate changes made to the Quantification Methodology and Calculator Tool

B. Quantification Methodology Using CalEEMod

- Updated the methodology to use CalEEMod 2016[1] from CalEEMod 2013
  - The trip rates from Institute of Transportation Engineers (ITE) 9th edition of the Trip Generation Manual were incorporated
  - The regional default data provided by the air districts/local Metropolitan Planning Organizations (MPO) (e.g., architectural coating ROG content limits, percentage of wastewater treatment (septic tanks/aerobic/anaerobic), MPO trip rate information, number of snow days vs. summer days waste treatment plant specific effluent nitrogen, etc.) has been incorporated
  - The calculation methodologies for GHG mitigation measures LUT-1, LUT-4, LUT-6, LUT- 9, and WSW-1 have been corrected. Also, the model has been revised so that the mitigation measures, when applied, will recognize when the user changes the defaults.
- Updated screen shots from CalEEMod 2016
- Updated Project Setting to align with the AHSC Project Area Types per the AHSC Guidelines
- Revised the equation for calculating LUT-1 in the "Additional Benefits" section of the AHSC Calculator Tool to adjust the baseline density to be consistent with the minimum required dwelling units per acre in the AHSC Guidelines for the applicable project setting (see Table 2 for minimum requirements);
- Updated PDT-1 to cap maximum potential VMT reductions at 12.5 percent by limiting project specific input to CalEEMod to 25 percent per CAPCOA Quantification Report

[1] For a list of updates to CalEEMod see: http://www.aqmd.gov/docs/default-source/caleemod/completelistofchanges.pdf

- Removed LUT-5 and ICP/RIPA Adjustment as all projects must be within a half-mile of transit per AHSC Guidelines
- Updated SDT-2 to include the list of acceptable traffic calming measures per the CAPCOA Quantification Report
- Removed LUT-9 to prevent duplicative scoring to the walkability index; this measure will be scored using the walkability index in the scoring criteria of the AHSC Guidelines
- Removed Commute Measures since these apply to employees and implemented by employers of commercial land use types which may not be known at time of application
- Relocated LUT-4 from additional benefits to CalEEMod as the GHG mitigation measure calculation methodology has been corrected in CalEEMod
- Relocated Transit Improvement Measures to TAC methods to estimate GHG emission reductions from stand-alone transportation projects
- Set the number of residents eligible for subsidies to one eligible resident per dwelling unit ~~consistent with AHSC Program Guidelines requirement to provide one subsidy per unit~~
- Provide outputs for key variable and air pollutant estimates utilizing VMT reductions estimated using CalEEMod

C. Quantification Methodology Using TAC Methods

- Updated language to clarify the different active transportation measure types
- Added language to require applicants to obtain concurrence from transit agency partners (e.g., increase in ridership)
- Updated method for calculating GHG emission reductions for pedestrian facilities to match the method for calculating GHG emission reduction for bike facilities
- Added Class 4 Bikeways and Bike Share project types as quantifiable active transportation measures
- Added Capital Improvements that encourage mode-shift as a quantifiable transportation measure
- Updated project area to align with AHSC Project Area Guidance for Sustainable Transportation Infrastructure
- Provide outputs for key variable and air pollutant emission estimates utilizing VMT reductions estimated using the TAC methods

Appendix A

- Updated example to match updated Quantification Methodology

Appendix C

- Removed Appendix C. Project Setting Types which included project setting definitions per the CAPCOA Quantification Report to match updates

Appendix D

- Included Capital Improvements
- Updated Method to match updated Quantification Methodology in Section C
- Updated Train Emission Factor Table

- Updated equations to match updated Quantification Methodology

Appendix E

- Removed Appendix E. All emission factors and associated calculations have been moved to the CCI Quantification Methodology ~~Draft~~ Emission Factor Database (~~Draft~~ Database), available at: www.arb.ca.gov/cci-quantification. The ~~database~~ Database includes new emission factors for criteria and toxic air pollutant and no changes have been made to the GHG emission factors

Calculator Tool

- ~~Updated the AHSC Calculator Tool as necessary to reflect changes in the Quantification Methodology~~
- Added calculations and emission factors to estimate air pollutant emission estimates
- ~~Addition of~~ Added a new output tab in the AHSC Calculator Tool that summarizes key variables and air pollutant emission estimates
- GHG emission reductions, key variables, and air pollutant estimates are prorated according to the level of program funding contributed from AHSC and other CCI programs, as applicable

Program Assistance

CARB staff will review the quantification portions of the AHSC project applications to ensure that the methods described in this document were properly applied to estimate the GHG emission reductions and air pollutant emission estimates for the proposed project. Applicants should use the following resources for additional questions and comments:

- Applicants are encouraged to check the frequently asked questions (FAQ) page regularly during the application process, which is at: www.arb.ca.gov/cci-quantification.
- Questions on this document should be sent to GGRFProgram@arb.ca.gov.
- For more information on CARB's efforts to support implementation of GGRF investments, see: www.arb.ca.gov/auctionproceeds.
- Questions pertaining to the AHSC Program should be sent to ahsc@sgc.ca.gov.

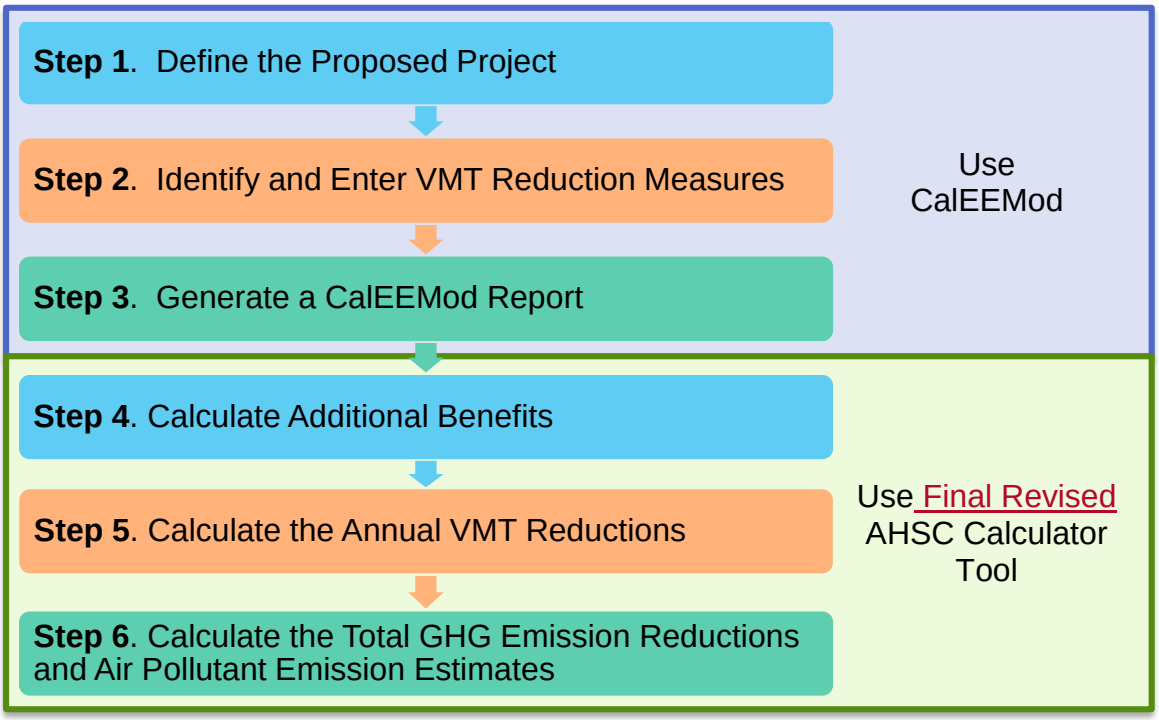
Section B. Quantification Methodology Using CalEEMod

Overview

This Final Revised AHSC Quantification Methodology estimates passenger VMT reductions, and the corresponding GHG emission reductions and air pollutant emission estimates of a proposed AHSC project based on specific project characteristics and project features. CalEEMod combines project specific data with default data to establish an initial case and a project case. The difference between the initial case and project case is the quantified GHG emission reductions and air pollutant emission estimates from the VMT reduction features identified in the proposed project.

Applicants will follow the steps outlined in Figure 2 to estimate the VMT reductions for the proposed project using CalEEMod. In CalEEMod, the VMT associated with the initial case is referred to as the "Unmitigated VMT" and the VMT associated with the project case is referred to as the "Mitigated VMT." Use CalEEMod for ~~steps~~ Steps 1 through 3 and the Final Revised AHSC Calculator Tool for ~~steps~~ Steps 4 through 6.

Figure 2. Steps for Estimating VMT Reductions Using CalEEMod

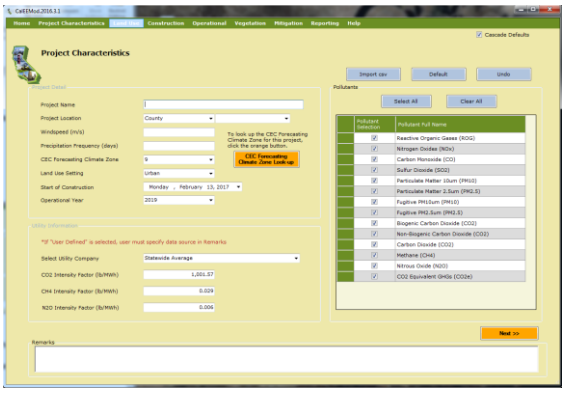


Steps 1—3: Overview

CalEEMod will be used for ~~steps~~ Steps 1 through 3. Refer to the Tools section for more information on CalEEMod and where to obtain the software.

Step 1: Define the Proposed Project

Project Characteristics Screen



Cascade Defaults: Leave this box checked

Project Name: Enter project pin number and project name

Project Location: Select "County" and enter the county of the project site

Climate Zone: Enter any climate zone from the drop-down box[2] (Windspeed and Precipitation will autofill)

Land Use Setting: For RIPA project types, select "Rural;"[3] otherwise, select "Urban"

Start of Construction: Leave as default values[4]

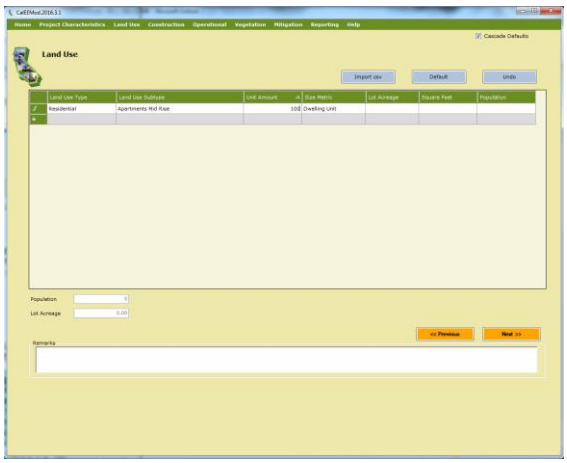
Operational Year: Enter the first year of operation of the proposed project

Select Utility Co.: Select "Statewide Average"[5] (CO_2, CH_4, and N_2O Intensity Factors will autofill)

Pollutants: All boxes should remain checked[4]

[2] The climate zone for a project can be looked up using CalEEMod's User's Guide Appendix F - Climate Zones Zip Code/Cities Lookup, Climate Zone Zip Code/Cities Lookup or the Climate Zone Map. However, the applicant may enter any allowable climate zone as this information is not used for calculations in this Quantification Methodology.
[3] The use of "rural" must be consistent with the definition in the AHSC Guidelines.
[4] These values are not used in the computation of VMT.
[5] CalEEMod is used to develop VMT estimates only; GHGs are calculated outside of CalEEMod.

Land Use Screen



Cascade Defaults: Leave this box checked

Land Use Type: Select "Residential" or "Commercial" (See Appendix B) (multiple rows may be used to characterize the proposed project)

Land Use Subtype: See Appendix B (multiple rows may be used to characterize the proposed project)

Unit Amount:

Residential Land Use Types:	Enter number of dwelling units
Non-residential Land Use Types:	Enter the square footage in thousands (i.e., if the non-residential floor area is 10,000 square feet, enter "10" as the Unit Amount)

Size Metric:

Residential Land Use Types:	Select "Dwelling Unit"
Non-residential Land Use Types:	Select "1,000 sqft"

Lot Acreage: Leave as default values[4]

Square Feet: Leave as default values[4]

Population: Leave as default values[4]

Applicants should not enter any values into the following screens: Construction, Operational, and Vegetation.

User Tip:
Residential land use types include assumptions on parking; therefore, the applicant does not need to add parking as an additional land use type.

Step 2: Identify and Enter VMT Reduction Measures

Applicants should identify land use and other project features that would result in reduced VMT and enter the applicable project data into the Traffic Mitigation "Land Use & Site Enhancement" screen according to the instructions below.

Mitigation: Traffic → Land Use & Site Enhancement Screen
Project Setting: The Project Settings in CalEEMod are based on the definitions provided in the CAPCOA Quantification Report and are used to determine the maximum VMT reductions possible based on the project's location and project-specific features.

For purposes of this Quantification Methodology, Project Settings have been aligned with the AHSC Project Area Type per the AHSC Program Guidelines. Applicants must select the Project Setting based on the Project Area Type of their AHSC Project as described in Table 2.

Table 2. Project Settings in the "Land Use & Site Enhancement" Screen by Project Area Type

Project Area Types	Minimum Net Density	CalEEMod Project Setting*	Maximum VMT Reductions
TOD	30 du/acre	Urban	75%
ICP	20 du/acre	Urban Center[6]	40%
RIPA	15 du/acre	Low Density Suburban[7]	15%

*Listed in order of decreasing maximum potential reductions

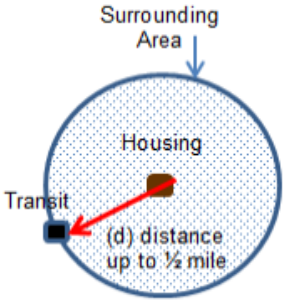
Note: for the purposes of this Quantification Methodology, Suburban Center has been removed as an applicable project setting.

Select the VMT reduction measures that apply to the project according to Table 3 for Land Use and Site Enhancement Measures. Note that some of the measures will be calculated in Step 4 (Additional Benefits). For each measure selected, applicants must provide supporting documentation.

User Tip:
Applicants must check the appropriate box of the measure and enter any necessary data into CalEEMod. Applicants should not check the box of measures calculated outside of CalEEMod or that do not apply to the project.

[6] Referred to as "Compact Infill" in the CAPCOA Quantification Report.
[7] Referred to as "Suburban" in the CAPCOA Quantification Report.

NOTE: For all measures that rely on features within the project area, the metrics should be evaluated for an area within the housing development and surrounding area which can extend a distance (d) from the housing development not to exceed one-half (½) mile, as shown below. The applicable measures are also denoted with "**(a)**" in Table 3 in the "VMT Reduction Measure" column. For example, the VMT Reduction Measure [PDT-3] "On-Street Market Pricing" indicates the parking policy/pricing should be evaluated according to this note.



Parking Policy/Pricing Measures		
PDT-1	Limit Parking Supply	Project par or eliminat
PDT-2	Unbundle Parking Costs	Project par separate
PDT-3	On-Street Market Pricing[(a)]	On-street p pricing (suc

Table 3. "Land Use & Site Enhancement" VMT Reduction Measures

ID[8]	VMT Reduction Measure	Use this Measure if…	Project Specific Data Inputs Required by CalEEMod[9]	Maximum Potential VMT Reduction by Measure[10]	Maximum Potential VMT Reduction by Group
Land Use & Site Enhancement Measures					
LUT-1	Increase Density	Housing development density is greater than the minimum required dwelling units per acre[11]	**Do not use in CalEEMod; See Step 4** Dwelling units per acre of project	30%	Urban: 65% Urban center: 30% Low density suburban: 5%
LUT-3	Increase Diversity	Multiple land use types in project	Select for mixed-use developments (no additional data required)	30%	
LUT-9	Improve Walkability Design	This measure was removed from use in this Quantification Methodology.	**Do not use[12]**	21.3%	
LUT-4	Improve Destination Accessibility	Project is within 12 miles of a Central Business District (CBD)	Enter the distance to CBD[13] (>12)	20%	
LUT-5	Increase Transit Accessibility	This measure was removed from use in this Quantification Methodology.	**Do not use[14]**	24.6%	
LUT-6	Integrate Below Market Rate Housing	Project incorporates affordable housing	**Enter Percentage of units (not # of Units)** that are affordable[15] (0-100)	4%[15]	

[8] Measures listed in the order shown on the CalEEMod screens. IDs reference to the CAPCOA Quantification Report.
[9] Values in parentheses indicate valid inputs.
[10] Range of effectiveness derived from the CAPCOA Quantification Report, except as noted.
[11] Revision to the equation for calculating LUT-1 in the "Additional Benefits" section of the AHSC Calculator Tool to adjust the baseline density to be consistent with the minimum required dwelling units per acre in the AHSC Guidelines for the applicable project area type
[12] Measure has been removed to circumvent duplicative scoring to the walkability index
[13] See Appendix C. Central Business District. Applicants must estimate the Distance to CBD using the CARB tool available at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/kml/jobcentermap.html
[14] Measure has been removed since all AHSC projects are required to be within half-mile of transit.
[15] The CAPCOA Quantification Report states the maximum reduction potential as 1.2%; however, the maximum reduction potential is 4% (see http://www.montgomeryplanning.org/transportation/documents/TripGenerationAnalysisUsingURBEMIS.pdf). The reduction is applied correctly in CalEEMod.

Table 3. (continued) "Land Use & Site Enhancement" VMT Reduction Measures

ID[8]	VMT Reduction Measure	Use this Measure if…	Project Specific Data Inputs Required by CalEEMod[9]	Maximum Potential VMT Reduction by Measure[10]	Maximum Potential VMT Reduction by Group[10]
Neighborhood Enhancement Measures					
SDT-1	Improve Pedestrian Network[(a)]	Project area includes a pedestrian access network	**Do not use in CalEEMod; See Section C**	2%	5%
SDT-2	Provide Traffic Calming Measures	Project's streets and intersections feature traffic calming features (Complete Street features)[16]	**Do not use in CalEEMod; See Step 4**	1%	
SDT-3	Implement NEV Network	This measure was removed from use in this Quantification Methodology	**Do not use**[17]	12.7%	
Parking Policy/Pricing Measures					
PDT-1	Limit Parking Supply	Project parking requirements are reduced or eliminated	% reduction in residential spaces below ITE avg. weekday parking generation rate[18] (0-25%)[19]	12.5%	20%
PDT-2	Unbundle Parking Costs	Project parking and property costs are separate	Monthly parking cost ($0-$200)	20%[20]	
PDT-3	On-Street Market Pricing[(a)]	On-street parking utilizes market-rate pricing (such as meters)[21]	% increase in price (0-50%)	5.5%	

[16] The CAPCOA Quantification Report lists the following as acceptable traffic calming measures: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees and chicanes/chokers. Applicants will be required to document which traffic calming feature(s) will be implemented in order to take credit for this measure.
[17] This measure pertains to low-speed, arterial road vehicles, as classified in the California Vehicle Code Section 385.5.
[18] See Appendix B for default ITE parking rates.
[19] The CAPCOA Quantification Report states that the maximum reduction potential is 12.5%; however, CalEEMod allows up to 20% reduction. Users may only enter a % reduction up to 25% to achieve the maximum reduction of 12.5%.
[20] The CAPCOA Quantification Report states that the maximum reduction potential is 13% for parking costs of $125; however, CalEEMod allows up to 20% reduction for parking costs of $200.
[21] If the project area will increase parking rates between the time of application to building occupancy and the rate of increase is known, applicants may use this measure. Users may only enter an increase in price up to 50%.

Table 3. (continued) "Land Use & Site Enhancement" VMT Reduction Measures

ID[8]	VMT Reduction Measure	Use this Measure if…	Project Specific Data Inputs Required by CalEEMod[9]	Maximum Potential VMT Reduction by Measure[10]	Maximum Potential VMT Reduction by Group[10]
Transit Improvement Measures					
TST-1	Provide BRT System[(a)]	These measures have been relocated to the TAC Methods.	**Do not use in CalEEMod; See Section C**	3.2%	10%
TST-3	Expand Transit Network[(a)]			7.4%	
TST-4	Increase Transit Frequency[(a)]			3.1%	

Step 3: Generate a CalEEMod Report

Reporting Screen

Select "Annual"

Click "Recalculate All Emissions and Run Report"

User Tip:
GHG and air pollutant emissions are calculated outside of CalEEMod based on the VMT estimates generated in CalEEMod.

CalEEMod will generate a report that includes annual Total VMT estimates of the project for both the initial case, which is identified as "unmitigated" in the CalEEMod report, and the project case, identified as "mitigated." The VMT outputs are found in the Section 4.2 as shown in Figure 3. The unmitigated annual VMT is the estimated VMT that would occur if the project did not include the mitigation features selected in CalEEMod; the mitigated annual VMT accounts for the land use features selected. These CalEEMod outputs will be used as inputs to the CARB-developed Final Revised AHSC Calculator Tool, which is described in ~~steps~~ Steps 4 through 6.

Figure 3. CalEEMod Report Section 4.2 VMT Output

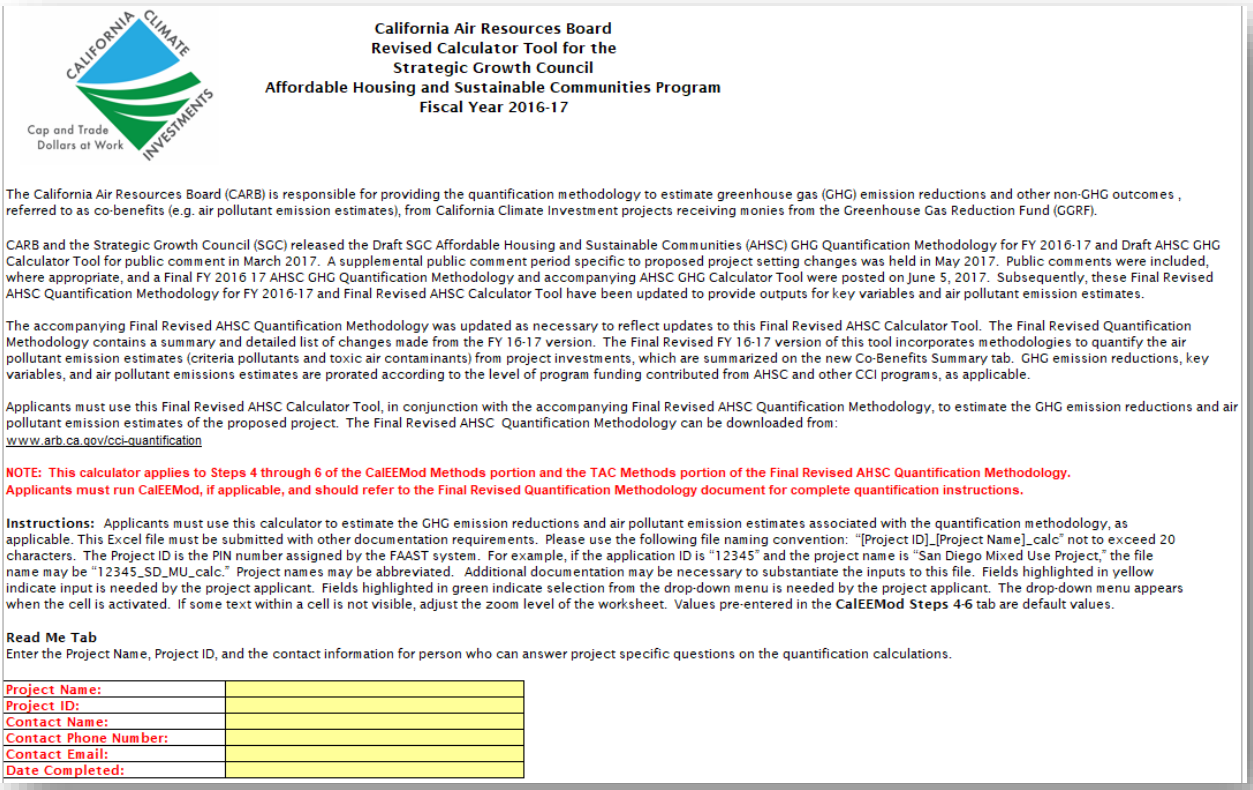
4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	659.00	716.00	607.00	~~1,882,065~~	~~1,466,443~~
Total	659.00	716.00	607.00	1,882,065	1,466,443

Applicants must submit both the input and output files used to generate the VMT data, in Excel format. Applicants are requested to name the input and output files using the following format: "[Pin#]_[ProjectName]_input/output" not to exceed 20 characters. For example, if the application pin number is "12345," the project name is "San Diego Bay Housing," and the file is the input file, the file name may be "12345_SDBay_input." Project names may be abbreviated.

Steps 4—6: Overview

Applicants must use the Excel-based Final Revised AHSC Calculator Tool for ~~steps~~ Steps 4 through 6. The equations used in the calculations are based on CalEEMod and the CAPCOA Quantification Report and are provided in Appendix D. The Final Revised AHSC Calculator Tool can be downloaded from the CCI quantification materials website at: www.arb.ca.gov/cci-quantification. Applicants must begin with the **Read Me** tab, which contains instructions and prompts users to enter project information.



California Air Resources Board
Revised Calculator Tool for the
Strategic Growth Council
Affordable Housing and Sustainable Communities Program
Fiscal Year 2016-17

The California Air Resources Board (CARB) is responsible for providing the quantification methodology to estimate greenhouse gas (GHG) emission reductions and other non-GHG outcomes , referred to as co-benefits (e.g. air pollutant emission estimates), from California Climate Investment projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF).

CARB and the Strategic Growth Council (SGC) released the Draft SGC Affordable Housing and Sustainable Communities (AHSC) GHG Quantification Methodology for FY 2016-17 and Draft AHSC GHG Calculator Tool for public comment in March 2017. A supplemental public comment period specific to proposed project setting changes was held in May 2017. Public comments were included, where appropriate, and a Final FY 2016 17 AHSC GHG Quantification Methodology and accompanying AHSC GHG Calculator Tool were posted on June 5, 2017. Subsequently, these Final Revised AHSC Quantification Methodology for FY 2016-17 and Final Revised AHSC Calculator Tool have been updated to provide outputs for key variables and air pollutant emission estimates.

The accompanying Final Revised AHSC Quantification Methodology was updated as necessary to reflect updates to this Final Revised AHSC Calculator Tool. The Final Revised Quantification Methodology contains a summary and detailed list of changes made from the FY 16-17 version. The Final Revised FY 16-17 version of this tool incorporates methodologies to quantify the air pollutant emission estimates (criteria pollutants and toxic air contaminants) from project investments, which are summarized on the new Co-Benefits Summary tab. GHG emission reductions, key variables, and air pollutant emissions estimates are prorated according to the level of program funding contributed from AHSC and other CCI programs, as applicable.

Applicants must use this Final Revised AHSC Calculator Tool, in conjunction with the accompanying Final Revised AHSC Quantification Methodology, to estimate the GHG emission reductions and air pollutant emission estimates of the proposed project. The Final Revised AHSC Quantification Methodology can be downloaded from:
www.arb.ca.gov/cci-quantification

NOTE: This calculator applies to Steps 4 through 6 of the CalEEMod Methods portion and the TAC Methods portion of the Final Revised AHSC Quantification Methodology.
Applicants must run CalEEMod, if applicable, and should refer to the Final Revised Quantification Methodology document for complete quantification instructions.

Instructions: Applicants must use this calculator to estimate the GHG emission reductions and air pollutant emission estimates associated with the quantification methodology, as applicable. This Excel file must be submitted with other documentation requirements. Please use the following file naming convention: "[Project ID]_[Project Name]_calc" not to exceed 20 characters. The Project ID is the PIN number assigned by the FAAST system. For example, if the application ID is "12345" and the project name is "San Diego Mixed Use Project," the file name may be "12345_SD_MU_calc." Project names may be abbreviated. Additional documentation may be necessary to substantiate the inputs to this file. Fields highlighted in yellow indicate input is needed by the project applicant. Fields highlighted in green indicate selection from the drop-down menu is needed by the project applicant. The drop-down menu appears when the cell is activated. If some text within a cell is not visible, adjust the zoom level of the worksheet. Values pre-entered in the **CalEEMod Steps 4-6** tab are default values.

Read Me Tab
Enter the Project Name, Project ID, and the contact information for person who can answer project specific questions on the quantification calculations.

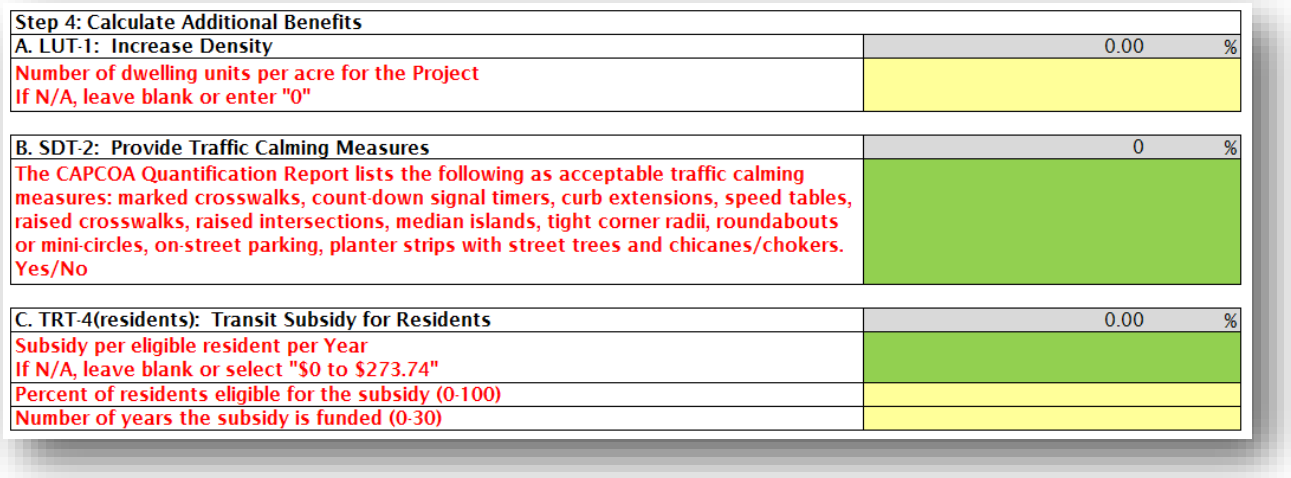
Project Name:	
Project ID:	
Contact Name:	
Contact Phone Number:	
Contact Email:	
Date Completed:	

Step 4: Calculate Additional Benefits

Applicants should enter the requested information for the measures that apply to the project in the "CalEEMod Steps 4-6" tab of the Final Revised AHSC Calculator Tool. The Final Revised AHSC Calculator Tool will display the percent VMT reductions by measure. For measures that do not apply to the project, inputs should be left as defaults, resulting in no change to VMT for those measure(s).

The Final Revised AHSC Calculator Tool provides additional benefits for the following measures if applicable to the proposed project, as described in Table 3:

A. LUT-1: Increase Density
B. SDT-2: Provide Traffic Calming Measures
C. TRT-4(residents): Transit Subsidy for Residents. Note: The CalEEMod Transit Subsidy is applicable to non-residential land use types (for employees). This adjustment has been provided to apply transit subsidies to residents. For the purposes of estimating the percent of residents eligible for subsidy, use one eligible resident per dwelling unit.



Step 4: Calculate Additional Benefits		
A. LUT-1: Increase Density	0.00	%
Number of dwelling units per acre for the Project If N/A, leave blank or enter "0"		
B. SDT-2: Provide Traffic Calming Measures	0	%
The CAPCOA Quantification Report lists the following as acceptable traffic calming measures: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees and chicanes/chokers. Yes/No		
C. TRT-4(residents): Transit Subsidy for Residents	0.00	%
Subsidy per eligible resident per Year If N/A, leave blank or select "$0 to $273.74"		
Percent of residents eligible for the subsidy (0-100)		
Number of years the subsidy is funded (0-30)		

Step 5: Calculate the ~~CalEEMod~~ Annual VMT Reductions

This Step calculates the annual VMT reductions according to the project features and the maximum potential reductions according to the Project Setting as listed in Table 4. This Step is automated and no user input is required.

Table 4. Maximum Potential Reductions by Project Setting Type

CalEEMod Project Setting Types*	Maximum Potential Reductions (Total maximum project VMT reduction)[22]
Urban	75%
Urban Center	40%
Low Density Suburban	15%

*Listed in order of decreasing maximum potential reductions

Step 6: Calculate the Total ~~CalEEMod~~ GHG Emission Reductions and Air Pollutant Emission Estimates

This Step converts the annual VMT reductions to annual GHG emission reductions, estimates air pollutant emissions, and calculates the GHG emission reductions and air pollutant emissions over the life of the project, 30 years. This Step is automated and no user input is required.

Methods and equations used in the ~~Draft~~ Final Revised AHSC Calculator Tool for estimating the GHG emission reductions and air pollutant emission estimates are provided in Appendix D. Emission factors used in calculations are contained in the ~~Draft~~ Database available at: www.arb.ca.gov/cci-quantification. Documentation on the sources and methods used to develop the emission factors is also provided.

[22] As defined in the CAPCOA Quantification Report. The interactions among transportation-related measures are complex and sometimes counter-intuitive. The maximum reduction values are derived from the percentage difference in per capita VMT compared against a statewide average and reflect the highest reduction levels justified by the literature as reviewed for the CAPCOA Quantification Report.

Step 5: Calculate the Annual VMT Reductions		
Additional % VMT Reductions (A+B+C from Step 4)	0.00	%
Additional VMT Reductions	-	VMT
Total Annual VMT Reductions	-	VMT
Percent VMT Reduction	0%	%

Maximum Potential Annual Reductions		VMT

Annual VMT Reductions	-	**VMT**

Step 6: Calculate the Total GHG Emission and Air Pollutant Reductions	
GHG Emission Reductions	
GHG Emission Reductions (Yr 1)	MT CO_2e
GHG Emission Reductions (Yr F)	MT CO_2e
Total GHG Emission Reductions	MT CO_2e
Criteria Pollutant Reductions	
Reactive Organic Gases (ROG) Reductions (Yr 1)	lbs
Reactive Organic Gases (ROG) Reductions (Yr F)	lbs
Nitrogen Oxide (NO_x) Reductions (Yr 1)	lbs
Nitrogen Oxide (NO_x) Reductions (Yr F)	lbs
Particulate Matter ($PM_{2.5}$) Reductions (Yr 1)	lbs
Particulate Matter ($PM_{2.5}$) Reductions (Yr F)	lbs
Total ROG Criteria Pollutant Reductions	**lbs**
Total NO_x Criteria Pollutant Reductions	**lbs**
Total $PM_{2.5}$ Criteria Pollutant Reductions	**lbs**
Toxic Air Contaminant Reductions	
Diesel PM Reductions (Yr 1)	lbs
Diesel PM Reductions (Yr F)	lbs
Total Diesel PM Toxic Pollutant Reductions	**lbs**

If your project has features requiring use of TAC Methods, go to **Section C. Quantification Methodology Using TAC Methods**; otherwise, go to **Section D. Documentation**.

Section C. Quantification Methodology Using TAC Methods

Overview

TAC Methods are provided for eligible capital projects (e.g., sustainable transportation infrastructure, transit-related amenities, etc.) and program costs (e.g., Active Transportation Programs) that encourage mode-shift that are not quantified in CalEEMod. Applicants should identify the applicable TAC Method(s) as described in Table 5 based on the proposed project features. For GHG quantification purposes, eligible AHSC projects fall into the three project types.

Table 5. TAC Methods by Project Type

Project Type	Description	TAC Method
Operation of New/Expanded Bus, Train, Ferry, Vanpool, or Shuttle Service	Expansion of transit service through new service, additional routes, extended routes, extended service hours, increased frequency of service, or increased capacity.	$Emission\ Reductions = Emissions\ of\ Displaced\ Autos - Emissions\ of\ New/Expanded\ Service\ Vehicle$
Capital Improvements (that encourage mode-shift)	Capital Improvements that result in an increase in transit ridership such as: new transit facilities that connect to pedestrian or bike paths; upgrades to transit stops/stations (e.g., bike-sharing facilities, bike racks/lockers, covered benches); and upgrades to transit vehicles (e.g., bicycle racks on buses, bicycle storage on rail cars).	$Emission\ Reductions = Emissions\ of\ Displaced\ Autos$
Active Transportation	Pedestrian Facilities, Bicycle Paths (Class 1), Bicycle Lanes (Class 2), Protected Bikeways (Class 4), or Bike Share, that are targeted to reduce commute and other non-recreational auto travel	$Emission\ Reductions = Emissions\ of\ Displaced\ Autos$

Projects that implement new and expanded transit service or capital improvement that generate increased ridership result in net GHG emission reductions by facilitating mode-shift from auto trips to transit trips, reducing VMT. Applicants are required to obtain concurrence from transit agency partners on the required inputs (e.g., increase in ridership resulting from the proposed AHSC project) and document how these inputs were derived; the supporting documentation will be reviewed during the application process. Transit agency partners are not required to be part of the application.

Pedestrian and bike facility construction projects and bike share projects result in net GHG emission reductions by replacing auto trips with walking or bicycle trips, which reduce VMT.

Pedestrian facilities replace auto trips by providing or improving pedestrian access. An example is a pedestrian passageway over several lanes of heavy traffic providing safe walking access to adjacent activity centers.

GGRF eligible bike facilities include Class 1, Class 2, and Class 4 bikeways, as defined below (from Assembly Bill 1193[v]).

- Class 1 bike paths or shared-use paths provide a completely separated right-of-way designated for the exclusive use of bicycles and pedestrians with crossflows by motorists minimized.

- Class 2 bike lanes provide a restricted right-of-way designated for the exclusive or semi-exclusive use of bicycles with through travel by motor vehicles or pedestrians prohibited, but with vehicle parking and crossflows by pedestrians and motorists permitted.

- Class 4 separated bikeways provide a right-of-way designated exclusively for bicycle travel adjacent to a roadway and which are protected from vehicular traffic by features such as grade separation, physical barriers, or on-street parking.

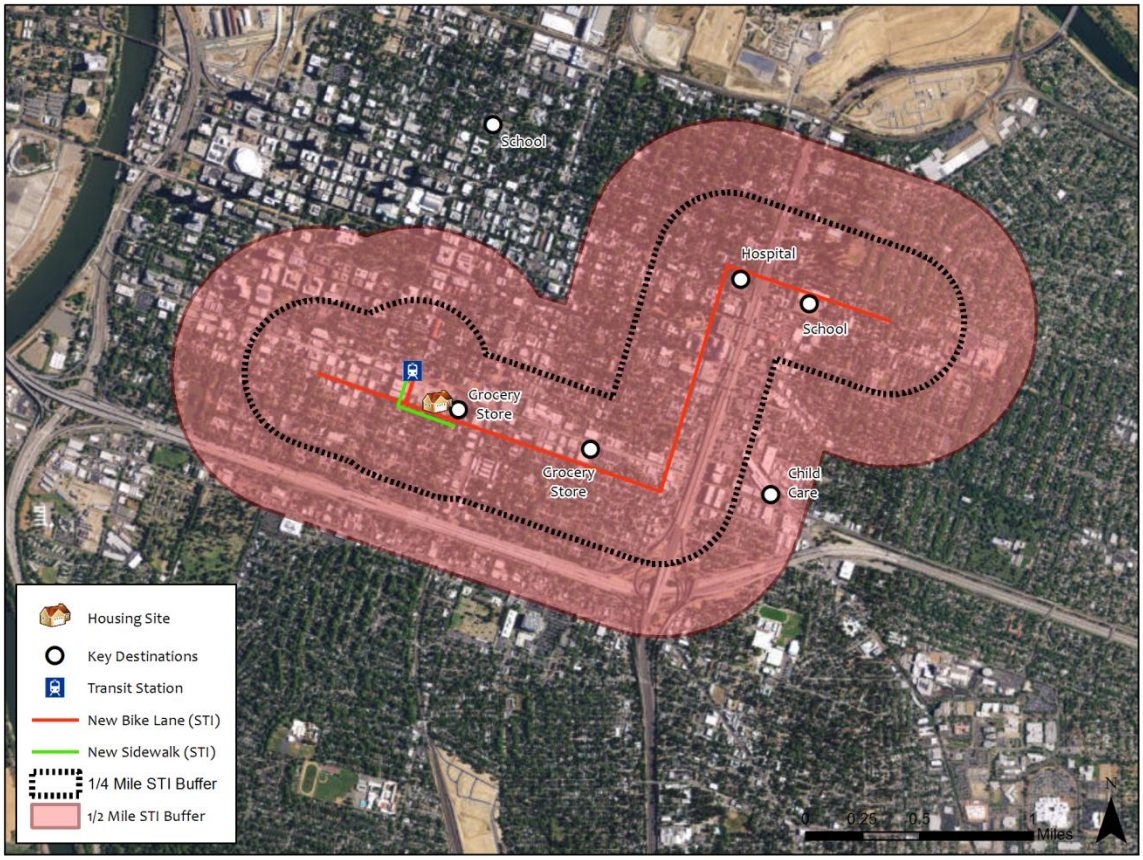
Multi-use projects (i.e., Class 1 Bike Path) that will result in reduced VMT from bicycle and pedestrian uses may account for both uses. Contiguous projects are considered to be a single project for quantification of GHG emission reductions.

Note that Class 3 bike routes, which provide a right-of-way designated by signs or permanent markings and shared with pedestrians and motorists, are not currently quantified in this methodology.

New and expanded bike share projects reduce VMT by providing access to bicycles and therefore replacing auto trips with bike trips. Applicants are encouraged to work with bike share partners to develop a reasonable estimate for bike trips based on project features and amenities installed as part of the proposed AHSC project; supporting documentation on how the input was derived will be reviewed during the application process.

Note: The AHSC Program estimates GHG emission reductions and air pollutant emissions associated with a decrease in VMT from a new or expanded transportation service or capital improvements that encourage mode-shift. GHG emission reductions and air pollutant emission estimates associated with replacement of vehicles in an existing service are not quantified.

For quantification purposes, the project area for Pedestrian Facilities, Bicycle Paths Class 1, Bicycle Paths Class 2, ~~Bikeway~~and Bikeway Class 4 has~~ve~~ been aligned with the Project Area Guidance for Sustainable Transportation Infrastructure projects. To determine the Activity Center Credit to apply, applicants should evaluate the surrounding area which can extend a distance from the proposed project not to exceed one-half (½) mile (shown as a red bubble), with the caveat that different credits are applied for activity centers within one-fourth (¼) mile (outlined by black dashed lines).



AHSC Calculator Tool

Applicants must use the Final Revised AHSC Calculator Tool to determine GHG emission reductions and estimate air pollutant emissions associated with proposed GGRF-funded projects. An example project showing how to use the Final Revised AHSC Calculator Tool is provided in Appendix A. ~~The equations used to estimate VMT in the calculations are based on the CMAQ Methods and are provided in Appendix D.~~ The Final Revised AHSC Calculator Tool can be downloaded from: www.arb.ca.gov/cci-quantification.

Methods and equations used in the ~~Draft~~ Final Revised AHSC Calculator Tool for estimating the GHG emission reductions and air pollutant emissions ~~estimates~~ are provided in Appendix D. Emission factors used in calculations are contained in the ~~Draft~~ Database available at: www.arb.ca.gov/cci-quantification. Documentation on the sources and methods used to develop the emission factors is also provided.

Users should begin with the **Read Me** tab, which contains instructions and prompts users to enter project information. Key terms are defined in the **Definitions** tab. The **TAC Inputs** tab identifies inputs required by the user, generally requiring project-specific data or assumptions. Input and output fields are color coded:

- Yellow fields indicate a direct user input is required.
- Green fields indicate a selection from a drop-down box is required.
- Gray fields indicate output or calculation fields that are automatically populated based on user entries and the calculation methods.

Details of calculation methods are provided in Appendix D.

Table 6 and Table 7 below indicate which factors in the **TAC Inputs** tab require input from the applicant ("✓"), and which values are either not applicable or have default values programmed into the Final Revised AHSC Calculator Tool (shaded cells) for transit projects and for pedestrian and bike projects respectively .

Table 6. TAC Input Requirements for Transit Projects

Input	Description	Project-Level Data Required			
		Bus / Shuttle/ Vanpool	Train	Ferry	Capital Imp.
Year 1	First Year of Project	✓	✓	✓	✓
Year F	**New/Expanded Service:** Last year of enforceable committed funds for the operation of the new/expanded service **Capital Improvements:** Last year of the useful life	✓	✓	✓	✓
Days of operation per year (D)	Days of use per year	Weekday Service: 260 Daily Service: 365			
Daily ridership (R)[23]	Change in Daily Ridership as a result of the project (may be different for Yr 1 and Yr F)	✓	✓	✓	✓
Adjustment factor (A) [24]	Adjustment factor to account for transit dependency	Local Bus: 0.5 Long Distance Commuter Bus, Shuttle, and Vanpool: 0.83	✓	✓	✓
Length (L)	Length of average auto trip reduced	Bus: 10.8 Shuttle: 16 Vanpool: 35	✓	✓	✓
Fuel Type	Fuel type of the new service vehicle	✓	✓	✓	
Engine MY	The engine model year of the new/expanded vehicle proposed for service, if applicable	✓			
Annual VMT / Units of Fuel	The annual VMT or units of fuel for the proposed service	VMT	VMT	Units of Fuel	

[23] Daily ridership must reflect the expected **increase** in daily ridership resulting from the proposed AHSC project; applicants should not include existing ridership.
[24] For projects where default values are not available, due to high variability, applicants are required to obtain concurrence from transit agency partners on the required inputs and document how these inputs were derived; the supporting documentation will be reviewed during the application process.

Table 7. TAC Input Requirements for Pedestrian and Bike Projects

Input	Description	Project-Level Data Required		
		Pedestrian Infrastructure	Bike Infrastructure	Bike Share
Year 1	First Year of Project	✓	✓	✓
Year F	Final Year of Useful Life	20 years	**Class 1:** 20 years **Class 2/4:** 15 years	10 years
Days of operation per year (D)	Days of use per year	200	200	
Length of average auto trip reduced (L)	Length of walk or bike trip in one direction	1.0 mile	1.8 miles	1.8 miles
Average Daily Traffic (ADT)	Annual Average Daily Traffic (two-way traffic volume in trips/day on parallel road). Use applicable value from project data (Maximum = 30,000)	✓	✓	
Yr1 Trips	Total number of bike trips using bike share bikes expected in the first year of service			✓[25]
Adjustment Factor (A)	**New Ped/Bike Infrastructure:** Adjustment factor to account for pedestrian/bike use. **Bike Share:** Discount factor applied to annual ridership to account induced demand and non-utilitarian or commuting use	Refer to Table D-3 in Appendix D	Refer to Table D-3 in Appendix D	0.5
Activity Center Credit (C)	Activity Center Credit near project	Refer to Table D-4 in Appendix D	Refer to Table D-4 in Appendix D	

Once the TAC Methods have been completed, go to **Section D. Documentation**.

[25] Applicants are encouraged to work with bike share partners to develop a reasonable estimate for bike trips based on project features and amenities installed as part of the proposed AHSC project; supporting documentation on how the input was derived will be reviewed during the application process. As an example, if a new bike share project includes installation of 20 bikes for a residential community for commuting purposes, it is reasonable to assume a fraction of the bikes will be used for a fraction of the year. An applicant who assumes 50% of the 20 bikes would be used on weekdays (i.e., 260 days) instead of driving would result in 5,200 trips eliminated per year (where 10 bike trips each way results in 20 one-way trips).

Section D. Documentation

In addition to AHSC application requirements, applicants applying for GGRF funding are required to document results from the use of this Final Revised AHSC Quantification Methodology, including supporting materials to verify the accuracy of project-specific inputs.

Applicants are required to provide electronic documentation that is complete and sufficient to allow the calculations to be reviewed and replicated. Paper copies of supporting materials must be available upon request by SCGC or CARB staff.

The following checklist is provided as a guide to applicants; additional data and/or information may be necessary to support project-specific input assumptions.

	Documentation Description	Completed
1.	Contact information for the person who can answer project specific questions from staff reviewers on the quantification calculations	
2.	Project description, including excerpts or specific references to the location in the main AHSC application of the project information necessary to complete the applicable portions of theis Final Revised AHSC Quantification Methodology	
3.	Populated Final Revised AHSC Calculator Tool file (in .xlsm) with worksheets applicable to the project populated (ensure that the Total Project GHG Emission Reductions, Total Project GHG Emission Reductions/AHSC GGRF Funds Requested, and Total Project GHG Emission Reductions/Total GGRF Funds Requested fields in the summary worksheet contain calculated values)	
4.	If the Total GGRF funds requested are different than the AHSC GGRF funds requested, provide an explanation of the other GGRF program(s) where funding is sought, including the fiscal yearFY of the application(s)	
5.	Electronic copies of the CalEEMod input and output files as described in Step 3 of Section B, including: • A list of the VMT reduction measures used in the proposed project with clearly identified project specific input data used in Section B • Documentation for determining Distance to Central Business District	
6.	Any other information as necessary and appropriate to substantiate inputs (e.g., -transit agency concurrence on increase in ridership or length of average auto trip reduced.)	

Total Project GHG Emission Reductions is equal to the sum total of each of the GHG Emission Reductions calculated in Sections B and C and are automatically summed in the Final Revised AHSC Calculator Tool in the **GHG Summary** tab.

Total Project GHG Emission Reductions per dollars of AHSC requested is calculated as:

$$\frac{Total\ Project\ GHG\ Emission\ Reductions\ in\ Metric\ tons\ (MT)\ of\ CO_2e}{AHSC\ Funds\ Requested\ (\$)}$$

Applicants should enter the AHSC Funds Requested ($) into the Final Revised AHSC Calculator Tool for all project features. The Final Revised AHSC Calculator Tool will provide the Total GHG Emission Reductions per AHSC Funds Requested.

Total Project GHG Emission Reductions per dollars of GGRF requested is calculated as:

$$\frac{Total\ Project\ GHG\ Emission\ Reductions\ in\ Metric\ tons\ (MT)\ of\ CO_2e}{Total\ GGRF\ Funds\ Requested\ (\$)}$$

Applicants should enter the GGRF Funds Requested ($) into the Final Revised AHSC Calculator Tool for all project features. The Final Revised AHSC Calculator Tool will provide the Total GHG Emission Reductions per GGRF Funds Requested.

The dollars requested from AHSC may be different from the dollars requested from GGRF if the applicant has applied for, anticipates applying for, or received funding for the proposed project through a separate GGRF program. If no other GGRF funds are requested, the Total Project GHG Emissions Reductions per dollars of GGRF and AHSC will be the same.

The **GHG Summary** tab displays the estimated:

- Total GHG emission reductions for the project- ($MTCO_2e$);
- AHSC GHG Emission Reductions;[26]
- Other CCI Emission Reductions;
- Total GHG emission reductions/Total GGRF dollar requested ($MTCO_2e$/$); and
- AHSC GHG Emission Reductions/AHSC Funds Requested ($MTCO_2e$/$).

The **Co-benefits Summary** tab displays the estimated:

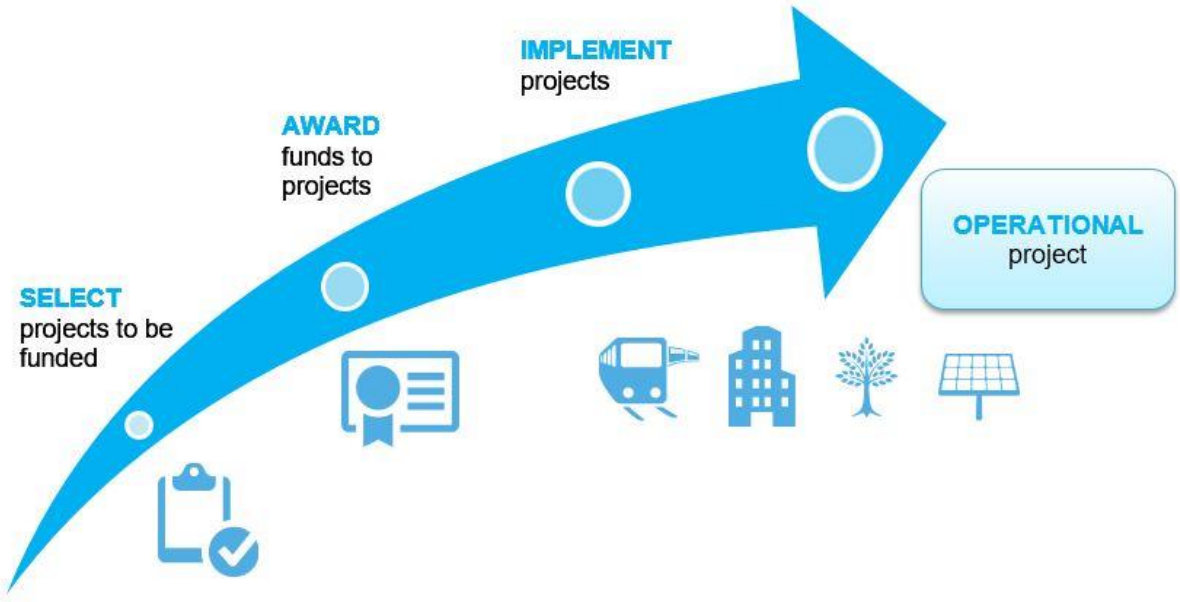
- Passenger VMT Reductions (miles);
- Net Density ~~for the project (Number of~~ dwelling units per acre~~) for the project~~;
- ROG emission estimates (lbs);
- NO_x emission estimates (lbs);
- $PM_{2.5}$ emission estimates (lbs); and
- Diesel PM emission estimates (lbs).

[26] This is the portion of GHG emission reductions attributable to funding from AHSC; GHG emission reductions are prorated according to the level of program funding contributed from AHSC and other CCI programs, as applicable.

Section E. Reporting after Funding Award

Accountability and transparency are essential elements for all CCI. All administering agencies are required to track project implementation and report on the benefits of those investments. CARB develops tracking and reporting guidance for CCI. The reporting process and requirements are found in Volume 3 of the Draft Funding Guidelines.[27] Draft Funding Guidelines Appendices 3.A and 3.B contain detailed reporting requirements that are specific to each project type or administering agency and cover all stages of reporting.

SGC will submit periodic reports to CARB. The specific data that need to be reported depend on the project type and the stage of project implementation at the time of reporting. Initially, administering agencies must report basic project information and expected benefits. As projects are implemented, administering agencies provide additional information on project status, benefits, and results. When projects are completed, administering agencies submit project closeout reports. A subset of projects, selected by SGC, will report on project outcomes upon reaching a specified milestone and being considered "operational."



SGC is required to collect and compile project data from funding recipients, including the GHG emission reductions estimated using this quantification methodology, co-benefits, and information on benefits to AB 1550[28] Populations. Reported information will be used to demonstrate how the Administration is achieving or exceeding the statutory objectives for CCI. Key variables and air pollutant emission

[27] CARB released updated draft Funding Guidelines in August 2017. These draft Funding Guidelines are subject to change based on public input and Board direction. While the draft provides an indication of what is currently required, administering agencies must incorporate all provisions reflected in the draft Funding Guidelines and subsequent Board approved Funding Guidelines.

[28] AB 1550, Gomez, Chapter 369, Statutes of 2016; amending Health and Safety Code Section 39713. Detailed information on AB 1550 requirements is provided in Volume 2 of the draft Funding Guidelines.

estimates are highlighted in the Co-benefits Summary tab of the Final Revised AHSC Calculator Tool. Funding recipients have the obligation to provide, or provide access to, data and information on project outcomes to SGC. Applicants should familiarize themselves with the requirements within the AHSC Guidelines, solicitation materials, and grant agreement, as well as the Draft CARB Funding Guidelines.

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[i] California Air Resources Board (2005). Methods to Find the Cost-Effectiveness of Funding Air Quality Projects for Evaluating Motor Vehicle Registration Fee Projects and Congestion Mitigation and Air Quality Improvement Projects. Available at: https://www.arb.ca.gov/planning/tsag/eval/eval.htm.
[ii] California Air Resources Board. www.arb.ca.gov/cci-fundingguidelines.
[iii] California Air Pollution Control Officers Association. Quantifying Greenhouse Gas Mitigation Measures. August 2010. http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf.
[iv] California Air Resources Board (2017). California Climate Investments Quantification Methodology Emission Factor Database. Available at: www.arb.ca.gov/cci-quantification.
[v] Assembly Bill 1193, available at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1193

Appendix A. Example Project

Introduction

The following is a hypothetical project[1] to demonstrate how the FY 16-17 Final Revised AHSC ~~GHG~~ Quantification Methodology and Final Revised AHSC Calculator Tool would be applied. This example does not provide examples of the supporting documentation that is required of actual project applicants.

Overview of the proposed project

The proposed project is a collaborative **TOD** project between a housing developer and a transit agency, proposing the following components:

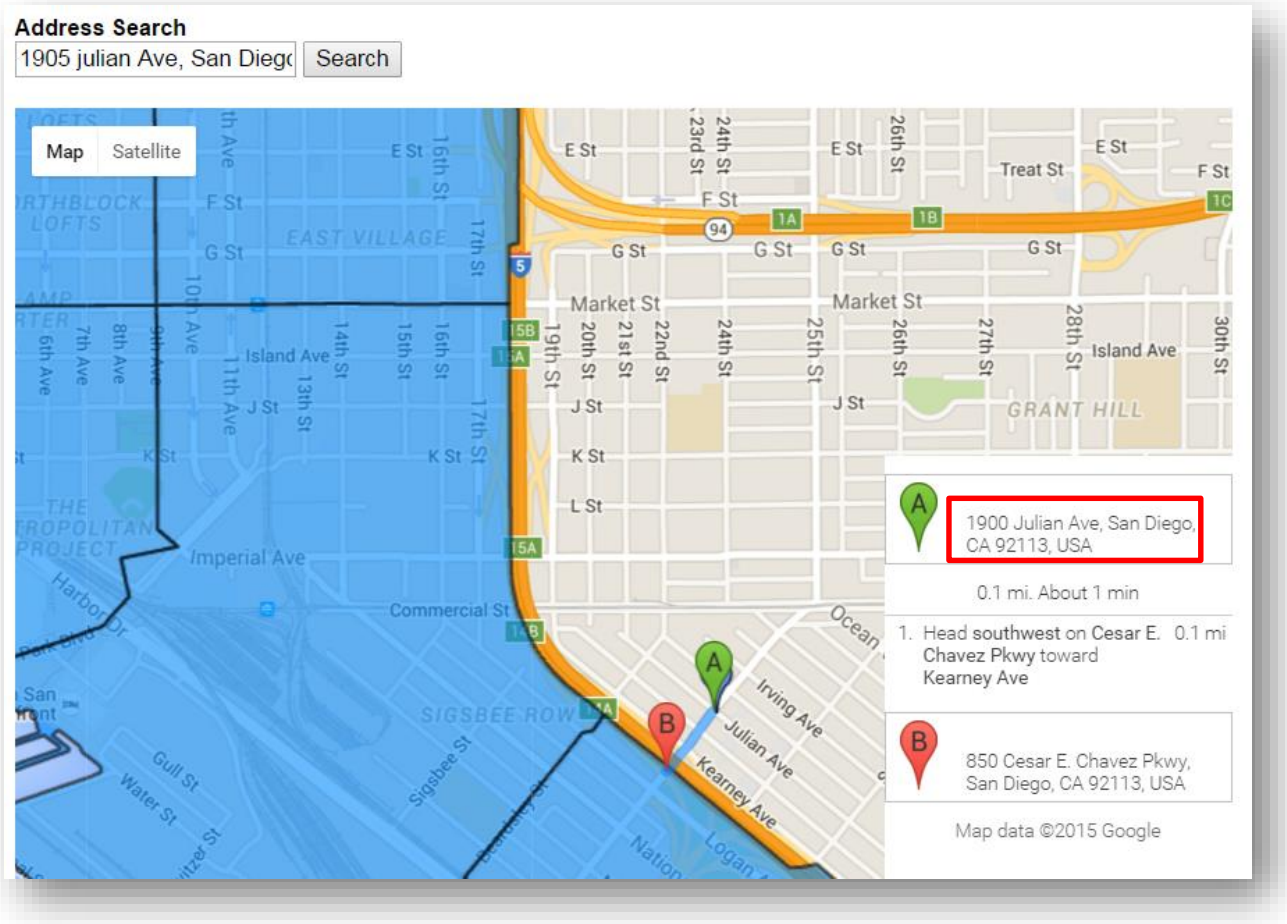
- Mixed-use development with affordable housing
- New bus service

The proposed project is located in San Diego County with the following project features:

- First year of development operation: 2019.
- 4-story rental development with 80 units; 75% are affordable.
- 3,000 square feet of commercial use.
- 2.0 acres (40 dwelling units per acre).
- Traffic calming measures (roundabouts).
- 1 parking space per dwelling unit (ITE default average weekday parking rate for a mid-rise urban apartment is 1.2 spaces per dwelling unit. This Quantification Methodology is requiring reductions from residential only; therefore, the project has a reduction in parking spaces of 18.7% [(1-1.23)/1.23]).
- The new hydrogen-powered bus service would be funded by AHSC funds for three years and therefore can demonstrate 3 years of operational funds. No subsidy is provided to riders.
- The new bus service would begin operation in 2019 and consist of 2 model year 2018 model year buses, with a ridership of 500 passengers per day on a daily service schedule.
- The new bus service would run 40,000 miles (total for 2 buses) per year.
- The application request is for $5,000,000 from the AHSC Program. No other GGRF funding is being or has been sought.
- The distance to the nearest Central Business District (CBD) is 0.1 miles, as shown on the next page.
- PIN number assigned by FAAST system: 12345.

[1] The hypothetical project has not undergone verification of any AHSC Program requirements; all assumptions about location type and features are for Quantification Methodology demonstration purposes only.

Refer to Appendix C for instructions on estimating Distance to CBD.



Methods to apply

According to Table 1 in the Final Revised AHSC Quantification Methodology, the applicant would use CalEEMod for the development portion of the project and TAC Methods for the new bus service.

As described in Section A of the Final Revised AHSC Quantification Methodology, users can download CalEEMod for free at www.caleemod.com. For Steps 4 through 6 of the CalEEMod component, the TAC Methods component, and some of the documentation components, CARB has developed an Excel-based Final Revised AHSC ~~c~~Calculator Tool. All applicants must use the Final Revised AHSC Calculator Tool~~calculator~~ for the applicable components of their project. The Final Revised AHSC Calculator Tool~~calculator~~ is available at CARB's Auction Proceeds Quantification Page, under the SGC's AHSC Program: www.arb.ca.gov/cci-quantification.

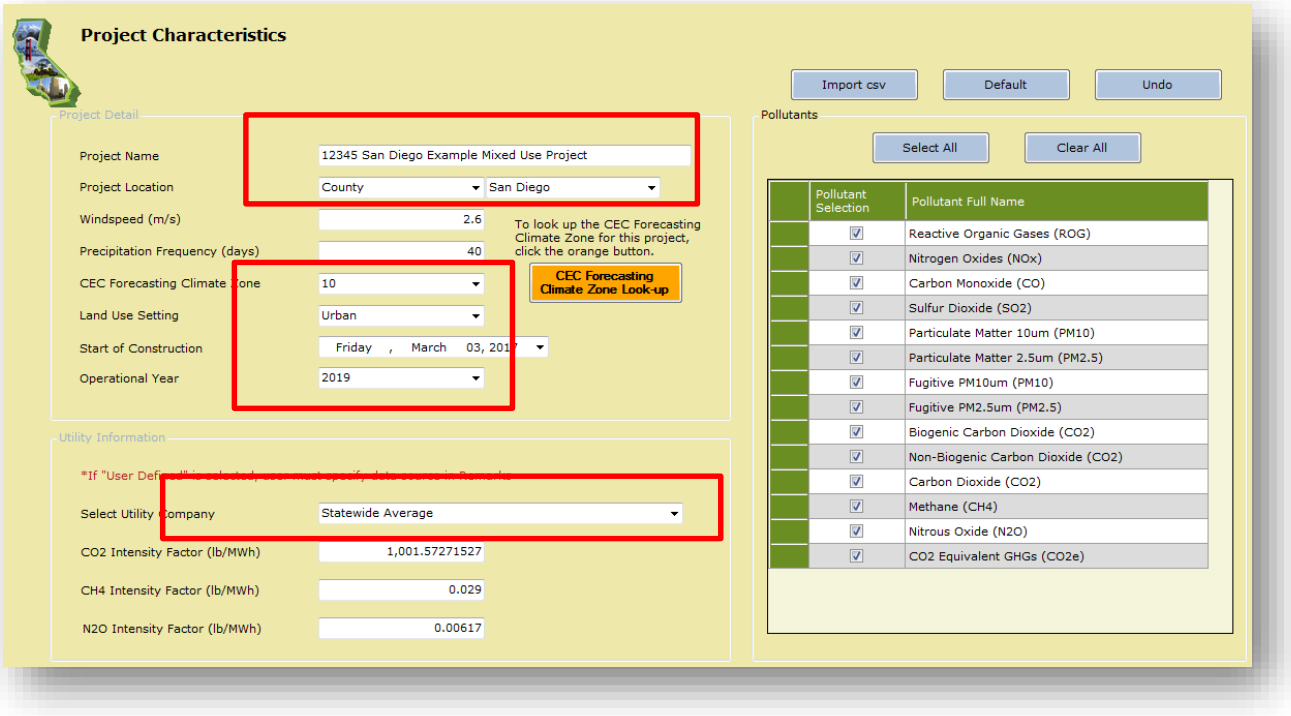
CalEEMod component

Step 1: Define the Pproposed Pproject ~~in CalEEMod~~

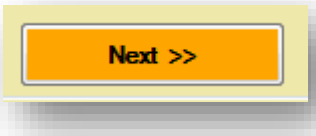
Project Characteristics Screen

Note: Include PIN number in Project Name

Project Name: 12345 San Diego Example Mixed Use Project
Project Location: "County" and San Diego
Climate zone: Choose any allowable zone
Land Use Setting: This is not a RIPA project, so select "Urban"
Start of Construction: Remain as default date
Utility: Statewide Average
Pollutants: All pollutants shall remain selected



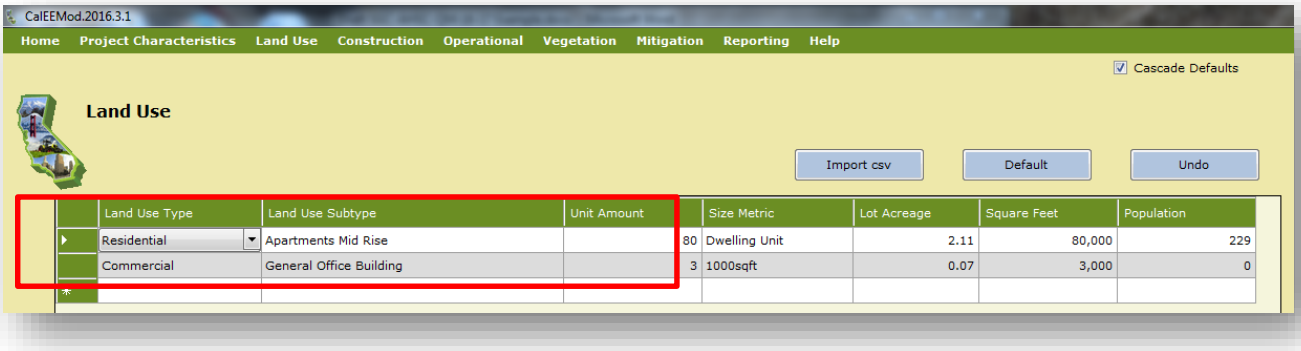
Click "Next."



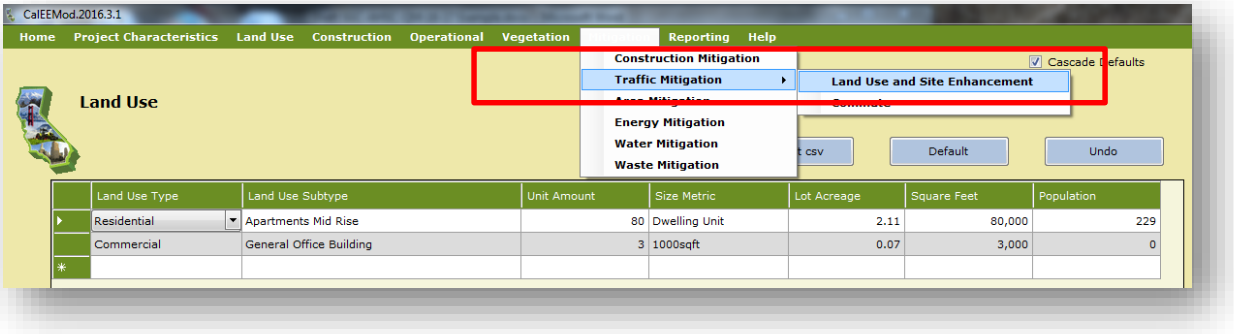
Land Use Screen

Refer to Appendix B to determine the appropriate Land Use Type and Land Use Subtype for each project component. Since the proposed project is a four-story rental apartment, it is classified as "Apartment Mid Rise" and all non-residential property is classified as "General Office Building."

Line 1: Residential, Apartment Mid-rise, "80" for the number of dwelling units
Line 2: Commercial, General Office Building, "3" for "thousands of square feet"



Select "Mitigation" > "Traffic Mitigation" > "Land Use and Site Mitigation."



Step 2: Identify and Enter VMT Reduction Measures

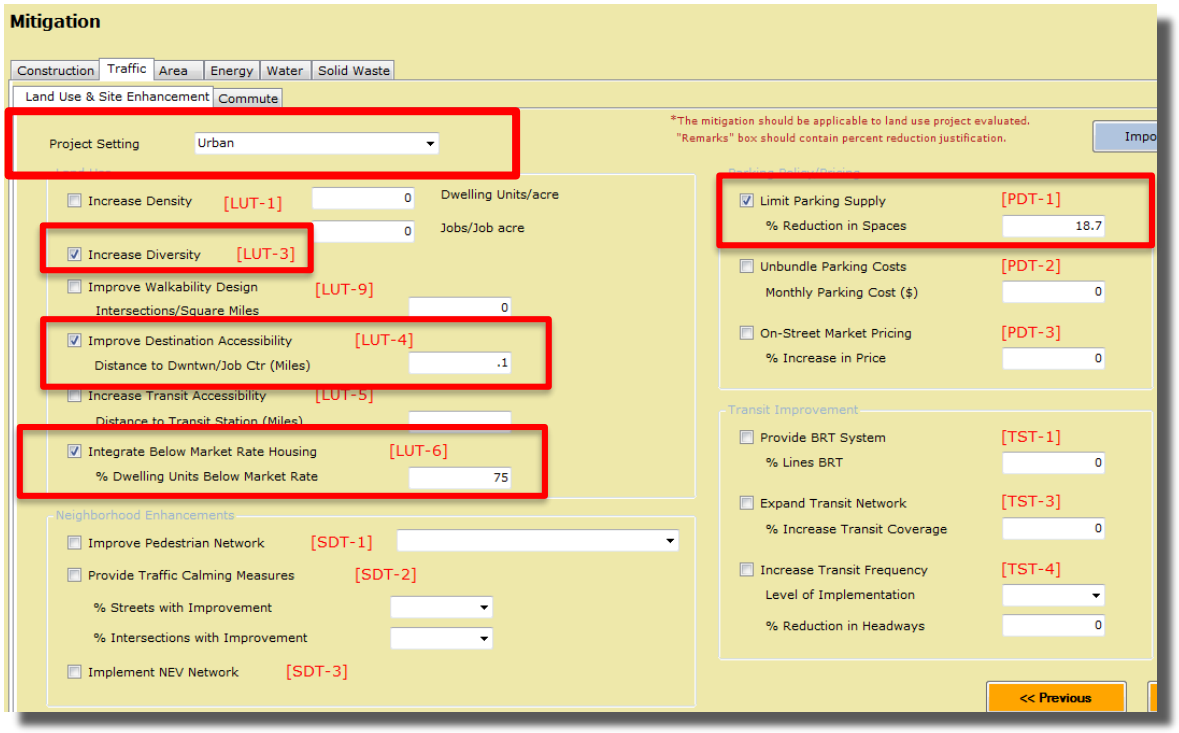
Mitigation: Traffic, Land Use & Site Enhancement Screen

Refer back to Table 3 of the Final Revised AHSC Quantification Methodology for additional information by measure. Note: CalEEMod may prompt the user to enter "Remarks" on some screens. These will not be reviewed as the supporting documentation for inputs.

Project Setting: "Urban"[2]
The project has the following features:
LUT-1, LUT-3, LUT-4, LUT-6, SDT-2 and PDT-1.
LUT-1 and SDT-2 are calculated outside of CalEEMod and must not be selected in CalEEMod.

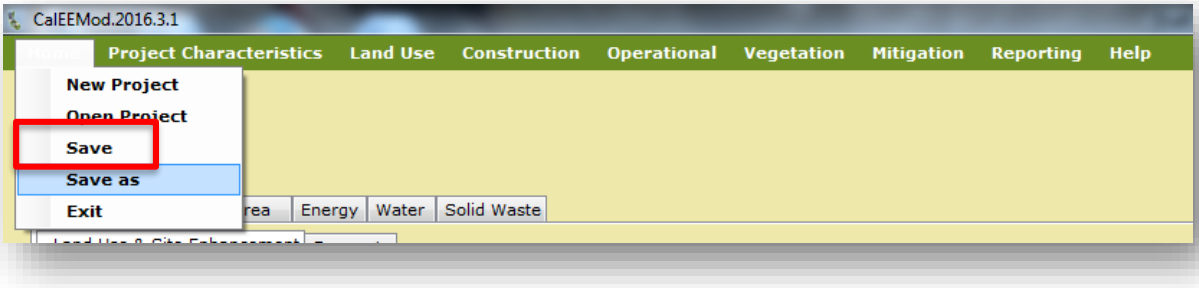
Enter the following in CalEEMod:
LUT-3: Check the box.
LUT-4: Check box and enter ".1" for Distance to CBD.
LUT-6: Check box and enter "75" for percent of units below market rate.
PDT-1: Check the box and enter "18.7" for percent reduction in spaces.

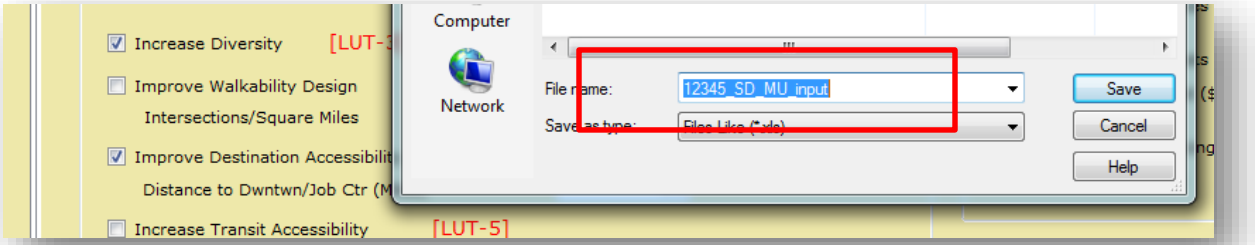
The other measures will be estimated in Step 4.



Under the Home tab, select "Save As" and save the input file as "12345_SD_MU_input."

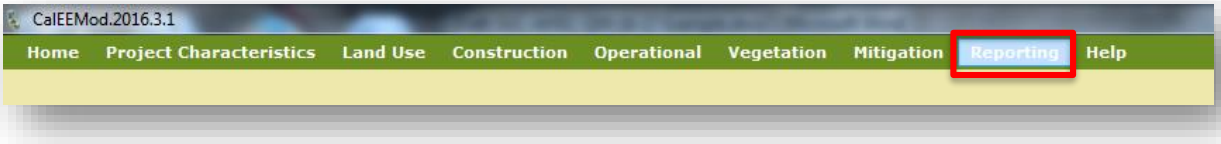
[2] The Project Setting selected must align with the Project Area Type; this is a TOD project, therefore the project setting is "Urban." This example is for demonstration purposes only. No analysis has been conducted to determine the Project Setting type or Project Area Type for this location.


CalEEMod.2016.3.1
Project Characteristics
Land Use
Construction
Operational
Vegetation
Mitigation
Reporting
Help
New Project
Open Project
Save
Save as
Exit
Energy
Water
Solid Waste


Increase Diversity
Improve Walkability Design
Intersections/Square Miles
Improve Destination Accessibilit
Distance to Dwntwn/Job Ctr (M
Increase Transit Accessibility
[LUT-5]
Computer
Network
File name:
12345_SD_MU_input
Save as type:
Save
Cancel
Help

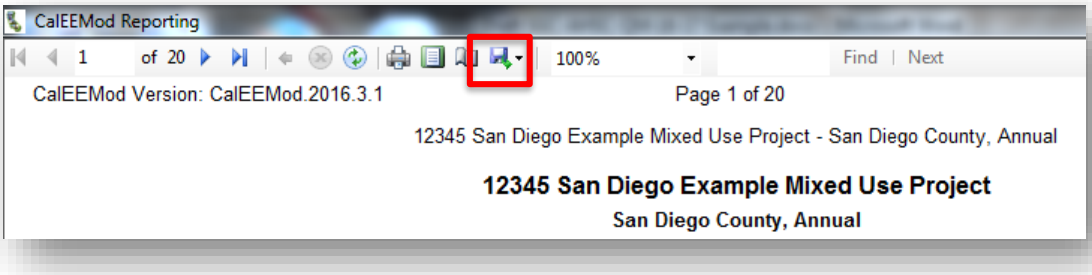
Step 3: Generate a CalEEMod Report

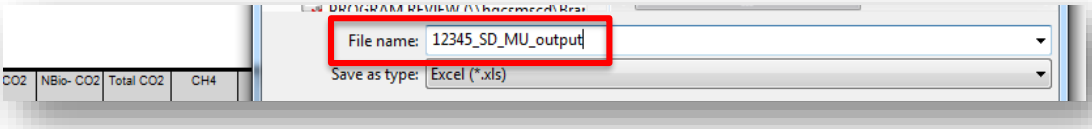
Select “Reporting.”



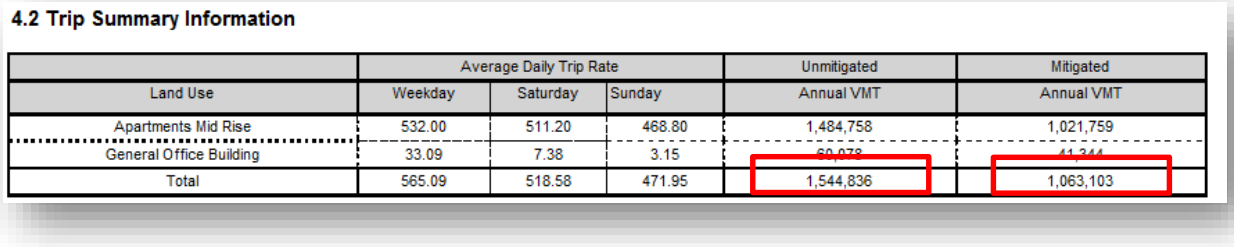
To run the model, select “Annual” and click on “Recalculate All Emissions and Run Report.” **Allow the program several minutes to run.**

Export the output as an Excel file named “12345_SD_MU_output.”





The output will include unmitigated annual VMT and mitigated annual VMT totals under Trip Summary Information, which will be used in the next steps.



4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	532.00	511.20	468.80	1,484,758	1,021,759
General Office Building	33.09	7.38	3.15	60,078	41,344
Total	565.09	518.58	471.95	1,544,836	1,063,103

Step 4—6

For Steps 4 through 6, use the Excel-based Final Revised AHSC ~~c~~Calculator Tool. The CalEEMod mitigated and unmitigated VMT and other project features will be used as inputs to the calculator.

The **Read Me** tab contains important instructions and basic project information must be inputted here.

Read Me Tab

Enter the Project Name, Project ID, and the contact information for person who can answ

Project Name:	12345 San Diego Mixed Use
Project ID:	12345
Contact Name:	Any R Body
Contact Phone Number:	(619) 555-555
Contact Email:	CARB@account.com
Date Completed:	10/2/2017

Proceed to the **CalEEMod Steps 4-6** tab and enter the basic project information in the green and yellow cells. The information entered must match the inputs (County, Project Type, Project Setting, and Year 1) and outputs (Unmitigated VMT and Mitigated VMT) from CalEEMod.

Project County	San Diego
Unmitigated VMT from the CalEEMod Report	1,544,836
Mitigated VMT from the CalEEMod Report	1,063,103
Project Type (must match AHSC Guidelines)	TOD
Project Setting (aligned with Project Type)	Urban
Year 1 (first operational year)	2019

Step 4: Calculate Additional Benefits

LUT-1 and SDT-2 apply to the project. Applicant should enter the number of dwelling units per acre for the Project as “40” and select “Yes” for providing traffic calming measures (see below). No other fields should be modified as the other measures are not applicable to the project.

Step 4: Calculate Additional Benefits		
A. LUT-1: Increase Density	2.33	%
Number of dwelling units per acre for the Project If N/A, leave blank or enter "0"	40.00	
B. SDT-2: Provide Traffic Calming Measures	1	%
The CAPCOA Quantification Report lists the following as acceptable traffic calming measures: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, roundabouts or mini-circles, on-street parking, planter strips with street trees and chicanes/chokers. Yes/No	Yes	
C. TRT-4(residents): Transit Subsidy for Residents	0.00	%
Subsidy per eligible resident per Year If N/A, leave blank or select "$0 to $273.74"		
Percent of residents eligible for the subsidy (0-100)		
Number of years the subsidy is funded (0-30)		

Step 5: Calculate the ~~CalEEMod~~ Annual VMT Reductions

This Step is automated. The calculator determines the annual VMT reductions.

Step 5: Calculate the Annual VMT Reductions		
Additional % VMT Reductions (A+B+C from Step 4)	3.33	%
Additional VMT Reductions	51,494.53	VMT
Total Annual VMT Reductions	533,227.53	VMT
Percent VMT Reduction	35%	%
Maximum Potential Annual Reductions	75%	VMT
Annual VMT Reductions	**533,227.53**	**VMT**

Step 6: Calculate the Total ~~CalEEMod~~ GHG Emission Reductions and Air Pollutant Emission Estimates

The calculator estimates the Total ~~CalEEMod~~ GHG emission reductions and air pollutant emissions.

Step 6: Calculate the Total GHG Emission and Air Pollutant Reductions		
GHG Emission Reductions		
GHG Emission Reductions (Yr 1)	262.70	MT CO_2e
GHG Emission Reductions (Yr F)	166.87	MT CO_2e
Total GHG Emission Reductions	**6,443.58**	MT CO_2e
Criteria Pollutant Reductions		
Reactive Organic Gases (ROG) Reductions (Yr 1)	28.085226	lbs
Reactive Organic Gases (ROG) Reductions (Yr F)	10.676459	lbs
Nitrogen Oxide (NO_x) Reductions (Yr 1)	122.210673	lbs
Nitrogen Oxide (NO_x) Reductions (Yr F)	43.884390	lbs
Particulate Matter ($PM_{2.5}$) Reductions (Yr 1)	2.152258	lbs
Particulate Matter ($PM_{2.5}$) Reductions (Yr F)	0.765883	lbs
Total ROG Criteria Pollutant Reductions	**581.425**	**lbs**
Total NO_x Criteria Pollutant Reductions	**2,491.426**	**lbs**
Total $PM_{2.5}$ Criteria Pollutant Reductions	**43.772**	**lbs**
Toxic Air Contaminant Reductions		
Diesel PM Reductions (Yr 1)	15.9320	lbs
Diesel PM Reductions (Yr F)	0.9873	lbs
Total Diesel PM Toxic Pollutant Reductions	**253.789**	**lbs**

TAC Method

New Bus Service

To determine the ~~Total~~ total GHG ~~Emission~~ emission ~~Reductions~~ reductions and air pollutant emission estimates from the new bus service, the applicant must use the **TAC Methods** tab in the calculator.

Go to the **TAC Inputs** tab and enter "New Bus Service (local bus)"; the fields that need to be inputted will turn yellow or green. Enter the following information according to the project's features: County, Year 1, Year F, Annual Days of Operation, Yr 1 Daily Ridership, and Yr F Daily Ridership (equal to Yr 1 Daily Ridership unless more detailed project information is available). The proposed project consists of two hydrogen-fuel buses that would each operate 2019-2022; therefore, the information for both buses may be entered in a single row. If there were any differences, such as a different Year 1 or fuel type, each bus would be entered on a separate line. The information, such as ridership and VMT, would be specific to the new or expanded service within each row.

Project Details							
Transit and Connectivity Method	County	Year 1 (Yr 1)	Year F (Yr F)	Annual Days of Operation (D)	Yr 1 Daily Ridership (R)	Yr F Daily Ridership (R)	Adjustment factor (A)
New Bus Service (local bus)	San Diego	2019	2022	365	500	500	
Total TAC Methods GHG Emission Reductions							

Scroll to the right to enter additional information: Fuel Type of the new bus service, Engine Model Year, and Annual VMT of the new bus service. The calculator will automatically provide the Total GHG Emission Reductions, key variables, and air pollutant emission estimates.

GHGs of New Service Vehicle					
Fuel Type	Engine MY	Hybrid Vehicle	Annual VMT/ Units of Fuel	Total GHG Emission Reductions (MTCO2e)	Quantification period Auto VMT Reductions
Hydrogen Fuel Cell	2018	No	40,000	1,250.55	2,956,500.00
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
				1,250.55	2,956,500.00

Net Benefits			
Total Reactive Organic Gas (ROG) Criteria Pollutant Reductions (lbs)	Total Nitrogen Oxide (NOx) Criteria Pollutant Reductions (lbs)	Total Particulate Matter ($PM_{2.5}$) Criteria Pollutant Reductions (lbs)	Total Diesel PM Toxic Pollutant Reductions (lbs)
136.7959	595.0472	11.8693	74.4357
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
136.80	595.05	11.87	74.44

Information for Documentation

The applicant should proceed to the **GHG Summary** tab and enter the Total AHSC Funds Requested and the Total GGRF Funds Requested to determine the Total GHG Emission Reductions per AHSC and GGRF Funds Requested, which are required documentation components.

Total GHG Emission Reductions and air pollutant emission estimates are automatically calculated from the **CalEEMod Steps 4—6** tab and **TAC Inputs** tab.

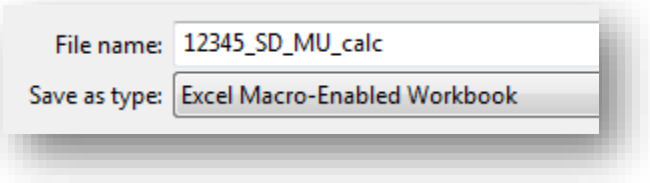
The AHSC funds requested may equal the Total GGRF funds requested if the applicant has not and does not plan to request funds for the same project and phase from other GGRF programs. In this case, applicants should enter the same dollar amount into both fields.

	GHG Emissions (MT CO_2e)	Description
Total CalEEMod GHG Emission Reductions	6,443.58	Total GHG emission reductions from CalEEMod component of project, if applicable.
Total TAC Methods GHG Emission Reductions	1,250.55	Total GHG emission reductions from TAC Methods component, if applicable.
Total GHG Emission Reductions	7,694.13	Total project GHG emission reductions in $MTCO_2e$ from the proposed project.
Total AHSC Emission Reductions	7,694.13	Portion of the GHG emission reductions attributable to funding from AHSC.
Total Other CCI Emission Reductions	-	Portion of the GHG emission reductions attributable to funding from another CCI program, as applicable.
AHSC GGRF Funds Requested ($)	5,000,000.00	AHSC GGRF Funds Requested for the proposed project.
Total AHSC GHG Emission Reductions / AHSC GGRF Funds Requested ($)	0.00153883	GHG Emission Reductions per AHSC GGRF funding requested.
Total GGRF Funds Requested ($)	5,000,000.00	Total GGRF Funds Requested for the proposed project. · If you are applying, have applied, or are planning to apply for additional GGRF funds for the proposed project, enter the combined funding request for all GGRF programs. · If you are applying only to AHSC for GGRF funding, re-enter the AHSC GGRF Funds Requested in the "Total GGRF Funds Requested ($)".
Total GHG Emission Reductions / Total GGRF Funds Requested ($)	0.00153883	GHG Emission Reductions per total GGRF funding requested. This may be the same as the AHSC GGRF Funds Requested UNLESS the same project and phase will seek or has sought funding from other GGRF programs. Applicants must provide details in this case.

The **Co-Benefits Summary** tab provides combines the key variable and air pollutant emission estimates from the CalEEMod and TAC components to provide a total for the project. Key variables are also prorated according to the level of program funding contributed from AHSC and other CCI programs, as applicable.

	Co-Benefits Summary	
	Total Project (CalEEMod + TAC)	
Key Variables	Passenger VMT Reductions (miles)	18,953,326
	Net Density (dwelling units/acre)	40
Co-Benefits	ROG Emission Reductions (lbs)	718.22
	NOx Emission Reductions (lbs)	3,086.47
	PM2.5 Emission Reductions (lbs)	55.64
	Diesel PM Emission Reductions (lbs)	328.23
	Total AHSC	
Key Variables	Passenger VMT Reductions (miles)	18,953,326
	Number of dwelling units per acre for the project	40
Co-Benefits	ROG Emission Reductions (lbs)	718.22
	NOx Emission Reductions (lbs)	3,086.47
	PM2.5 Emission Reductions (lbs)	55.64
	Diesel PM Emission Reductions (lbs)	328.23
	Total Other CCI	
Key Variables	Passenger VMT Reductions (miles)	0
	Number of dwelling units per acre for the project	0
Co-Benefits	ROG Emission Reductions (lbs)	0
	NOx Emission Reductions (lbs)	0
	PM2.5 Emission Reductions (lbs)	0
	Diesel PM Emission Reductions (lbs)	0

Save the file as instructed on the **Read Me** tab:



Applicants must submit the completed calculator along with other required documentation to SGC and CARB. Refer to Section D of the Final Revised AHSC Quantification Methodology and the AHSC Program Application for additional requirements.

Appendix B. Land Use Subtypes and Default Parking Rates

Residential Land Use Subtypes and Parking Rates

Applicants must select the residential land use subtype that most accurately reflects the type of development proposed in the application. For example, a senior housing project would most appropriately be classified as "Retirement Community." Table B-1 provides descriptions for the most common residential land use types. Definitions were derived using the CalEEmod User's Guide. For applicants using PDT-1, default ITE parking rates are also provided in Table B-1 and were derived from ITE Parking Generation, 4th Edition, Average Peak Period Parking Demand and the percent reduction should be calculated using only the residential land use information.

Table B-1. Residential Land Use Subtype Descriptions and Default Parking Rates

Residential Land Use Subtype	Description	ITE Default Parking Rates (spaces per dwelling unit)
Single Family Housing	All single-family detached homes on individual lots.	1.83
Apartments High Rise	High-rise apartments are units located in rental buildings that have more than 10 levels and most likely have one or more elevators.	1.37
Apartments Low Rise	Low-rise apartments are units located in rental buildings that have 1-2 levels.	1.23
Apartments Mid Rise	Mid-rise apartments in rental buildings that have between 3 and 10 levels.	Apartments with three or four stories should use 1.23; apartments with five to 10 stories should use 1.37
Condo/Townhouse	Ownership units that have at least one other owned unit within the same building structure.	1.38
Condo/Townhouse High Rise	Ownership units that have three or more levels.	1.38
Retirement Community	Communities that provide multiple elements of senior adult living.	0.59

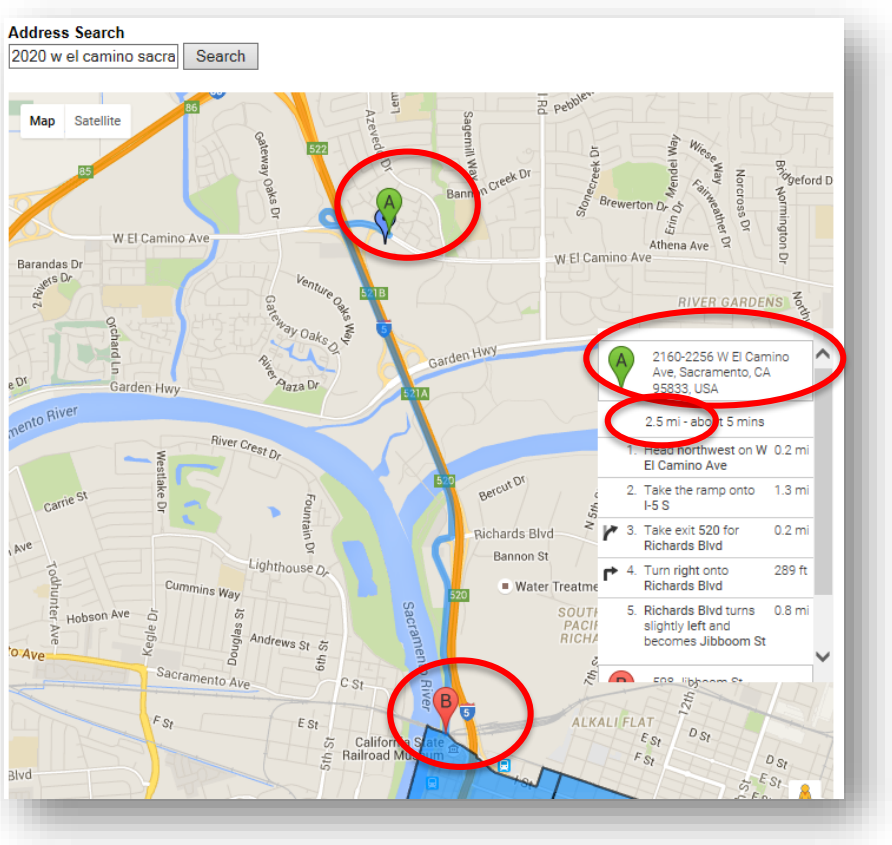
Non-Residential Land Use Subtypes and Parking Rates

For the non-residential component of mixed-use projects, the applicant must use a land use type of "Commercial" and a land use subtype of "General Office Building." PDT-1 only applies to residential land uses; therefore, no parking rate information is needed for non-residenical land use subtypes.

Appendix C. Distance to Central Business District

The distance from a project to a central business district (CBD) is used in Section B. ~~GHG~~ Quantification Methodology Using CalEEMod for LUT-4. CBD is defined as census tract (using 2011 census data) with at least 5,000 jobs per square mile. To determine the distance to CBD for a project, applicants must use the CARB tool available at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/kml/jobcentermap.html.

Applicants are instructed to submit a screenshot of the map that includes the "from" and "to" pins, the project address, and the project distance to CBD. An example screenshot with the required elements circled is shown below. In this example, the distance from the project to CBD is 2.5 miles. This value would be used in CalEEMoD for LUT-4, if applicable.



Appendix D. Equations Supporting the AHSC Calculator Tool

CARB developed the Excel-based Final Revised AHSC Calculator Tool to automate many of the portions of this Final Revised AHSC Quantification Methodology. This appendix provides the equations used in the Final Revised AHSC Calculator Tool for estimating the GHG emission reductions and air pollutant emission estimates for a project. The GHG emission reductions and air pollutant emission estimates from the project is quantified within the ~~Draft~~Final Revised AHSC Calculator Tool using the approaches described below. The ~~Draft~~ Database documentation explains how emission factors used in CARB quantification methodologies are developed.

CalEEMod Methods—Additional Benefits and Emission Calculations

Calculations supporting Section B steps 4 through 6 are provided below.

Step 4: Calculate Additional Benefits

The following equations support these measures:

A. LUT-1: Increase Density
B. SDT-2: Provide Traffic Calming Measures
C. TRT-4(residents): Transit Subsidy for Residents. Note: The CalEEMod Transit Subsidy is applicable to non-residential land use types (for employees). This equation has been provided to apply transit subsidies to residents. For the purposes of estimating the percent of residents eligible for subsidy, use one eligible resident per dwelling unit.

A. Increase Density (LUT-1)

$$\%\ Density\ Increase = 100 * \left[\frac{Project\ dwelling\ units\ per\ acre - Net\ Density}{Net\ Density}\right] \quad \textbf{(Eq. 1)}$$

$$\%\ VMT\ Reduction = 0.07 * \%\ Density\ Increase \quad \textbf{(Eq. 2)}$$

or 30% (whichever is lower)

Where,
Net Density is the minimum net density requirements as defined in the AHSC Guidelines by Project Area Type shown in Table D-1.

Table D-1. Net Density Lookup Table for Eq. 2

AHSC Guideline Requirements	
Project Area Type	Minimum Net Density
TOD	30 du/acre
ICP	20 du/acre
RIPA	15 du/acre

B. Provide Traffic Calming Measures (SDT-2)

$$\%\, VMT\ Reduction = 1\% \qquad \textbf{(Eq. 3)}$$

C. Transit Subsidy for Residents (TRT-4(residents))

$$\%\, VMT\ Reduction = A * B * \left(\frac{C}{30}\right) \qquad \textbf{(Eq. 4)}$$

Where,
A is the percent VMT reduction per eligible resident shown in Table D-2.

Table D-2. Adjustment Factor (A) Lookup Table for Eq. 4

Transit Subsidy or Discount per Year per Eligible Resident	A=Percent Reduction in Commute VMT per Eligible Resident		
	Low Density Suburban[1]	Urban Center[1]	Urban[1]
From $273.75 to $543.84	1.5%	6.2%	6.2%
$543.85 to $1,087.69	3.3%	12.9%	12.9%
$1,087.70 to $2,175.39	7.9%	20.0%	20.0%
$2,175.40 or greater	20.0%	20.0%	20.0%

Note: Subsidies below $273.75 per Eligible Resident per Year may not use this measure.

B is the percent of residents eligible for the subsidized or discounted transit program (i.e., 0-100). For the purposes of estimating the percent of residents eligible for subsidy, use one eligible resident per dwelling unit.

C is the number of years that the subsidy/discount is funded or guaranteed under the proposed project or transit agency program (i.e., 0-30 years).[2]

Example: A project providing a $2,500 per year subsidy to 100% of residents for 3 years would calculate the % VMT reduction as: % VMT reduction = [20% * 100 * (3/30)] = 2%.

[1] Refer to Project Setting designation based on the Project Area from Table 2.
[2] The subsidy/discount may include GGRF and other enforceable commitment funds.

Step 5: Calculate the ~~CalEEMod~~ Annual VMT Reductions

Annual VMT reductions

$$Additional\ \%\ VMT\ Reductions = Eq.2 + \ Eq.3 + Eq.4 \quad \textbf{(Eq. 5)}$$

$$Additional\ VMT\ Reductions = Unmitigated\ VMT * Additional\ \%\ VMT\ Reductions \quad \textbf{(Eq. 6)}$$

$$Total\ Annual\ VMT\ Reductions = Unmitigated\ VMT - Mitigated\ VMT + Additional\ VMT\ Reductions\ (Eq.6) \quad \textbf{(Eq. 7)}$$

Percent VMT Reductions for the project

$$Percent\ VMT\ Reduction = \frac{Total\ Annual\ VMT\ Reductions}{Unmitigated\ VMT} \quad \textbf{(Eq. 8)}$$

The project Maximum Potential Reductions according to the Project Setting is shown in Table D-3.

Table D-3. Maximum Potential Reductions by Project Setting Type

CalEEMod Project Setting Types*	Maximum Potential Reductions (Total maximum project VMT reduction)[3]
Urban	75%
Urban Center	40%
Low Density Suburban	15%

*Listed in order of decreasing maximum potential reductions

If the Percent VMT Reduction is greater than the Maximum Potential Reduction for the Project Setting, **Adjust** the Percent VMT Reduction:

$$Adjusted\ Percent\ VMT\ Reduction = Maxiumum\ Potential\ Reduction\ by\ Project\ Setting \quad \textbf{(Eq. 9)}$$

Annual ~~CalEEMod~~ VMT Reductions

$$Annual\ ~~CalEEmod~~\ VMT\ Reductions = (Adjusted) Percent\ VMT\ Reduction * Unmitigated\ VMT \quad \textbf{(Eq. 10)}$$

[3] As defined in the CAPCOA Quantification Report. The interactions among transportation-related measures are complex and sometimes counter-intuitive. The maximum reduction values are derived from the percentage difference in per capita VMT compared against a statewide average and reflect the highest reduction levels justified by the literature as reviewed for the CAPCOA Quantification Report.

Step 6: Calculate the Total ~~CalEEMod~~ GHG Emission Reductions and Air Pollutant Emission Estimates

~~CalEEMod~~ Emission Estimates ~~Reductions~~ for Year 1 and Year F:

$$\text{~~CalEEMod~~ Emission Estimates ~~Reductions~~ } (Yr\ 1) = \frac{\text{Annual CalEEMod VMT Reductions} * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 11)}$$

$$\text{~~CalEEMod~~ Emission Estimates ~~Reductions~~ } (Yr\ F) = \frac{\text{Annual CalEEMod VMT Reductions} * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 12)}$$

Where,
AVEF is the Auto Vehicle Emission Factor (grams per mile) by county for Year 1 or Year F. The life of the project is defined as 30 years; therefore, Year F = Year 1 + 30.

Total ~~CalEEMod~~ Emission ~~Reductions~~Estimates:

$$\text{~~CalEEMod~~ Emission ~~Reductions~~Estimates} = \frac{\text{~~CalEEMod~~Emission ~~Reductions~~Estimates}_{Yr\ 1} + \text{~~CalEEMod~~Emission ~~Reductions~~Estimates}_{Yr\ F}}{2} * 30$$

TAC Methods—Additional Benefits and Emission Calculations

Calculations supporting the TAC Methods are provided below.

New/Expanded Bus, Train, Shuttle, or Vanpool Service

Annual VMT of Displaced Autos from New/Expanded Service

$$Annual\ Auto\ VMT\ Reduced\ from\ New/Expanded\ Service = D * R * A * L \quad \textbf{(Eq. 14)}$$

Where,

Factor	Description	Default Values			
		Bus	**Train[4]**	**Shuttle**	**Vanpool**
D	Days of operation per year	260 (weekday service) 365 (daily service)	User-defined	260 (weekday service) 365 (daily service)	260 (weekday service) 365 (daily service)
R	Change in Daily ridership	Expected increase in daily ridership resulting from the implementation of the proposed AHSC project; applicants should not include existing ridership. For example, one additional bus rider commuting round trip per day is two bus trips per day.			
A	Adjustment factor to account for transit dependency	0.5 (local bus) 0.83 (long distance commuter)	User-defined	0.83	0.83
L	Length of average auto trip reduced	10.8 miles[5]	User-defined	16	35

Note: If the Ridership will vary over the life of the project, the applicant must calculate the Annual Auto VMT reduced for the first and last year of the project operation.

[4] Default values for new Train service are not available due to high variability. Applicants are required to obtain concurrence from transit agency partners on the required inputs and document how these inputs were derived; the supporting documentation will be reviewed during the application process.
[5] Average statewide trip length, per CalEEMod.

Auto Emission Reductions for Year 1 and Year F of the New/Expanded Service

$$Auto\ Emission\ Reductions\ (Yr\ 1) = \frac{(Annual\ VMT\ Reduced_{Yr\ 1}) * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 15)}$$

$$Auto\ \ Emission\ Reductions\ (Yr\ F) = \frac{(Annual\ VMT\ Reduced_{Yr\ F}) * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 16)}$$

Where,
AVEF is the Auto Vehicle Emission Factor (grams per mile).

New/Expanded Service Auto ~~GHG~~ Useful Life (UL) Emission Reductions

$$Auto\ UL\ Emission\ Reductions = \frac{Auto\ Reductions_{Yr1} + Auto\ Reductions_{YrF}}{2} * UL \quad \textbf{(Eq.17)}$$

Where,
UL is Useful Life, as defined as the number of years the project has enforceable committed funds for operation of the new/expanded service.

New/Expanded Service Emissions for Year 1 and Year F

$$Service\ Emissions\ (Yr\ 1) = \frac{(SVMT_{Yr\ 1}) * SEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 18)}$$

$$Service\ Emissions\ (Yr\ F) = \frac{(SVMT_{Yr\ F}) * SEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 19)}$$

Where,
SVMT is the annual VMT for the New/Expanded Service; and
SEF is the Emission Factor (grams ~~of~~ per mile) for the New/Expanded Service Vehicle.

New/Expanded Service ~~-~~Useful Life (UL) Emissions

$$Service\ UL\ Emissions = \frac{Service\ Emissions_{Yr1} + Service\ Emissions_{YrF}}{2} * UL \quad \textbf{(Eq. 20)}$$

New/Expanded Service Total Emission Estimate

$$New/Expanded\ Service\ Total\ \ Emissions\sout{Reductions} = Auto\ UL\ Emission\ Reductions - Service\ UL\ Emissions \quad \textbf{(Eq. 21)}$$

New Ferry Service

Annual VMT of Displaced Autos from New Service

$$Annual\ Auto\ VMT\ Reduced\ from\ New\ Service\ = D * R * A * L \quad \textbf{(Eq. 22)}$$

Where,

Factor	Description
D	Days of operation per year
R	Change in daily ridership as a result of the AHSC project
A	Adjustment factor to account for transit dependency
L	Length of average auto trip reduced

Note: If the Ridership will vary over the life of the project, the applicant must calculate the Annual Auto VMT reduced for the first and last year of the project operation. Applicants are required to work with transit agency partners to provide these values and document how these values were derived; the supporting documentation will be reviewed during the application process.

Auto Emission Reductions for Year 1 and Year F of the New/Expanded Service

$$New/Expanded\ Service\ Auto\ Reductions\ (Yr\ 1) = \frac{(Annual\ VMT\ Reduced_{Yr\ 1}) * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 23)}$$

$$New/Expanded\ Service\ Auto\ Reductions\ (Yr\ F) = \frac{(Annual\ VMT\ Reduced_{Yr\ F}) * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 24)}$$

Where,
AVEF is the Auto Vehicle Emission Factor (grams per mile).

New/Expanded Service Auto Useful Life (UL) Emission Reductions

$$Auto\ UL\ Reductions = \frac{Auto\ Reductions_{Yr1} + Auto\ Reductions_{YrF}}{2} * UL \quad \textbf{(Eq.25)}$$

Where,
UL is Useful Life, as defined as the number of years the project has enforceable committed funds for operation of the new/expanded service.

New/Expanded Service Emissions for Year 1 and Year F

$$Service\ Emissions\ (Yr\ 1) = \frac{(Fuel\ Consumption_{Yr\ 1}) * FEF}{1{,}000{,}000} \quad \textbf{(Eq. 26)}$$

$$Service\ Emissions\ (Yr\ F) = \frac{(Fuel\ Consumption_{Yr\ F}) * FEF}{1{,}000{,}000} \quad \textbf{(Eq. 27)}$$

Where,
Fuel Consumption is the amount of fuel consumed by the Ferry per year in Year 1 or Year F;
FEF is the carbon intensity Emission Factor (grams per unit of fuel) for the Ferry, according the type of fuel consumed.

New/Expanded Service Useful Life (UL) Emissions

$$Service\ UL\ Emissions = \frac{Service\ Emissions_{Yr\ 1} + Service\ Emissions_{Yr\ F}}{2} * UL \quad \textbf{(Eq. 28)}$$

New/Expanded Service Total Emission Estimate

$$Total\ Reductions = Auto\ UL\ Emission\ Reductions - Service\ UL\ Emissions \quad \textbf{(Eq. 29)}$$

Capital Improvements

Annual VMT of Displaced Autos

$$Annual\ Auto\ VMT\ Reduced = D * R * A * L \quad \textbf{(Eq. 30)}$$

Where,

Factor	Description
D	Days of operation per year
R	Change in daily ridership as a result of the AHSC project
A	Adjustment factor to account for transit dependency
L	Length of average auto trip reduced

Note: If the Ridership will vary over the life of the project, the applicant must calculate the Annual Auto VMT reduced for the first and last year of the project operation. Applicants are required to work with transit agency partners to provide these values and document how these values were derived; the supporting documentation will be reviewed during the application process.

Auto Emission Reductions for Year 1 and Year F

$$Auto\ Reductions\ (Yr\ 1) = \frac{(Annual\ VMT\ Reduced_{Yr\ 1}) * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 31)}$$

$$Auto\ Reductions\ (Yr\ F) = \frac{(Annual\ VMT\ Reduced_{Yr\ F}) * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 32)}$$

Where,
AVEF is the Auto Vehicle Emission Factor (grams per mile).

Total Useful Life (UL) Reductions

$$Total\ Reductions = \frac{Auto\ Reductions_{Yr1} + Auto\ Reductions_{YrF}}{2} * UL \quad \textbf{(Eq. 33)}$$

Where,
UL is Useful Life, as defined as the number of years the project has enforceable committed funds for operation of the new/expanded service.

Pedestrian Facilities, Bicycle Paths, Bicycle Lane, or Bikeways

Annual VMT Reductions of Displaced Autos from Pedestrian Facilities, Bicycle Path, Bicycle Lanes, and Bikeways

$$Auto\ VMT\ Reduced = (D) * (ADT) * (A + C) * (L) \quad \textbf{(Eq. 34)}$$

Where,

Factor	Description	Default Values
D	Days of use per year of new service	200
ADT	Annual Average Daily Traffic (two-way traffic volume in trips/day on parallel road. Use applicable value from project data (Maximum = 30,000)	Use project-specific data.
A	Adjustment factor to account for bike use	Use applicable value from Table D-3
C	Activity Center Credit near project	Use applicable value from Table D-4
L	Length of walk or bike trip in one direction	1.0 mile per walk trip 1.8 miles per bike trip

Table D-3. Adjustment Factor (A) Lookup Table for Eq. 34

Average Daily Traffic (ADT)	Length of Bike Project (one direction)	A (for cities >250,000 and non-university towns <250,000)	A (for university towns with population <250,000)
ADT ≤ 12,000 vehicles per day	≤ 1 mile	.0019	.0104
	> 1 & ≤ 2 miles	.0029	.0155
	> 2 miles	.0038	.0207
12,000 < ADT ≤ 24,000 vehicles per day	≤ 1 mile	.0014	.0073
	> 1 & ≤ 2 miles	.0020	.0109
	> 2 miles	.0027	.0145
24,000 < ADT ≤ 30,000 vehicles per day Maximum is 30,000	≤ 1 mile	.0010	.0052
	> 1 & ≤ 2 miles	.0014	.0078
	> 2 miles	.0019	.0104

Table D-4. Activity Center Credit (C) Lookup Table for Eq. 34

Count your Activity Centers. If there are…	Within 1/2 mile of Project Area	Within 1/4 mile of Project Area
3	.0005	.001
More than 3 but fewer than 7	.0010	.002
7 or more	.0015	.003

Activity Center examples: Bank, church, hospital or HMO, light rail station (park & ride), office park, post office, public library, shopping area or grocery store, university, or junior college. These metrics should be evaluated for the project location site and surrounding area which can extend a distance from the housing development not to exceed one-half (½) mile.

Auto ~~-~~Emission Reductions for Year 1 and Year F of the Pedestrian Facility, Bicycle Path, or Bicycle Lane, Bikeway

$$Auto\ Reductions_{Yr\ 1} = \frac{Auto\ VMT\ Reduced * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 35)}$$

$$Auto\ Reductions_{Yr\ F} = \frac{Auto\ VMT\ Reduced * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 36)}$$

Where,

AVEF is the Auto Vehicle Emission Factor (grams ~~-~~per mile)~~.~~; ~~found in the lookup table links in Table E-1~~.

Emission Reductions from the useful life of the Project

$$Emission\ Reductions = \frac{Auto\ Reductions_{Yr1} + Auto\ Reductions_{YrF}}{2} * UL \quad \textbf{(Eq. 37)}$$

Where,
UL is the useful life, which is 20 years for pedestrian facilities, 20 years for Class 1, and 15 years for Class 2~~,~~ and Class 4 bicycle lanes.

Bike Share

The emission reductions from Bike Share projects that result in an increase in bike trips are calculated as the emission reductions from displaced autos.

$$Auto\ VMT\ Reduced = (T) * (A) * (L) \quad \textbf{(Eq. 38)}$$

Where,

Factor	Description	Default Values
T	Total number of bike trips using bike share bikes expected in the first year of service	Use project-specific data
A	Adjustment factor to account for induced demand and non-utilitarian and/or non-commute use	Default is 0.5
L	Length of bike trip in one direction	1.8 miles per bike trip

Note: Applicants are encouraged to work with bike share partners to develop a reasonable estimate for bike trips based on project features and amenities installed as part of the proposed AHSC project; supporting documentation on how the input was derived will be reviewed during the application process. As an example, if a new bike share project includes installation of 20 bikes for a residential community for commuting purposes, it is reasonable to assume a fraction of the bikes will be used for a fraction of the year. An applicant who assumes 50% of the 20 bikes would be used on weekdays (i.e., 260 days) instead of driving would result in 5200 trips eliminated per year (where 10 bike trips each way results in 20 one-way trips).

Auto Emission Reductions for Year 1 and Year F of the bike share project

$$Auto\ Reductions_{Yr1} = \frac{Auto\ VMT\ Reduced * AVEF_{Yr\ 1}}{1{,}000{,}000} \quad \textbf{(Eq. 39)}$$

$$Auto\ Reductions_{YrF} = \frac{Auto\ VMT\ Reduced * AVEF_{Yr\ F}}{1{,}000{,}000} \quad \textbf{(Eq. 40)}$$

Where,
AVEF is the Auto Vehicle Emission Factor (grams per mile)~~; found in the Lookup table links in Table E-1~~.

Emission Reductions over the useful life of the project

$$Emission\ Reductions = \frac{Auto\ Reductions_{Yr1} + Auto\ Reductions_{YrF}}{2} * UL \quad \textbf{(Eq. 41)}$$

Where,

UL is the useful life, which is 10 years for a bike share project**.**